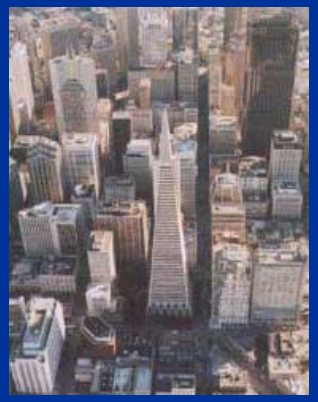


U.S. EPA *Pilot* RDD/IND Late-Phase Tabletop Training Exercise

Stuart Walker (OSRTI)
Scott Hudson (NDT)
John Cardarelli (NDT)
Jim Mitchell (Region 5)
Gene Jablonowski (Region 5)

Presented to the
ITRC Radionuclides Team Meeting
Saint Louis, Missouri
On May 9, 2007

Exercise Goals

- Allow EPA regional staff to practice late-phase planning
- Explore issues associated with making late-phase optimization decisions
- Identify needs and direction for future late-phase guidance and tools development
- Evaluate current EPA tools through RDD/IND simulation

Late-Phase RDD/IND Tabletop Exercise

- Tabletop exercise begins:
  - 60 days after RDD attack
  - 200 days after IND attack
- Pilot in San Francisco with EPA Region 9 staff participants only
- Subsequent TTX with other EPA Regional staff and outside EPA (e.g., federal, state, local gov't, industry, enviros, etc)

1.
Shortened Overview of RDD/IND WMD Response and format for Table Top Exercise

Responsibility

- DHS will assume overarching authority and responsibility
- EPA expected to work within this framework
  - Interagency guidance for terrorist use of dirty bombs and nuclear devices proposed 1-3-2006

PHASE	PROTECTIVE ACTION	DHS RDD/IND PROTECTIVE ACTION GUIDE
Early	Limit Emergency Worker Exposure	Normally 5 rems, higher values under emergency circumstances as needed
	Sheltering of Public	1 to 5 rem projected dose, normally initiated at 1 rem
	Evacuation of Public	1 to 5 rem projected dose, normally initiated at 1 rem
	Administration of Prophylactic Drugs	For KI, FDA Guidance dose values. For other drugs, consider on an ad hoc basis
Intermediate	Limit Worker Exposure	5 rems in compliance with OSHA regulations
	Relocation of General Public	2 rems, projected dose 1st Year
		Any subsequent year: 500 mrem projected dose
	Food Interdiction	500 mrem projected dose
	Drinking Water Interdiction	500 mrem dose
Late	**Final cleanup actions**	**Site specific level based on Optimization (focus of this Tabletop)**

DHS Guidance is NOT to be Used for CERCLA Response

- Do not use DHS optimization approach for selecting remedies
  - » Continue to use NCP 9 criteria for remedial (e.g., 10^{-4} to 10^{-6}, ARARs)
  - » Removal approach unchanged
- Do not use DHS early or intermediate PAGs as TBC
  - » CERCLA cleanup levels ***not*** based on guidance outside the risk range and/or expressed as a dose (# mrem/yr)
- Do not use DHS recovery process

DHS - Late Phase PAG

- Due to the extreme range of potential impacts, Subgroup determined that a numerical approach was not useful
- Subgroup determined that site-specific remediation and recovery strategies should be developed using principals of optimization

DHS - Optimization Process

- Determine societal objectives for expected land uses
- Develop and evaluate options and approaches
- Select the most acceptable criteria
- Flexible process
- Employs quantitative and qualitative assessments
- Applied at each stage of site restoration decision-making, from evaluation of remedial options to implementation of the chosen alternative

EPA CERCLA-like Approach for Today's TTX Optimization

- 10^{-4} to 10^{-6} or higher risk levels
- ARARs
- NCP 9 criteria
- OSWER directives
- May consider risk levels outside CERCLA risk range (10^{-3}, 10^{-2})

EPA Risk Assessment Tools Used for TTX

- Preliminary Remediation Goal (PRG) calculator
  - » Soil
- Building PRG calculator
  - » Settled dust
  - » Wall surfaces
  - » Wall volumetric
- Outside Surfaces PRG calculator
  - » Outside walls of buildings (surfaces and volumetric)
  - » Streets/pavement/pads (surfaces and volumetric)

DHS Response Teams and Groups

- Decision Team (DT)
- Recovery Management Team (RMT)
- Stakeholder Work Group (SWG)
- Technical Work Group (TWG)
  - TTX exercise will focus on this role

DHS - Recovery Process

- Through iterative process, TWG develops and forwards a sound, reasonable, and balanced remediation recommendation to the RMT for approval
- RMT transmits the approved recommendation(s) to the DT for final action
- The DT publishes a summary of the process, the options analyzed, and the final recommendation for public comment
- Public comments responded to, considered, and incorporated as appropriate (reconvening of the RMT, SWG and TWG may be necessary)
- Recovery operations implemented and evaluated for effectiveness

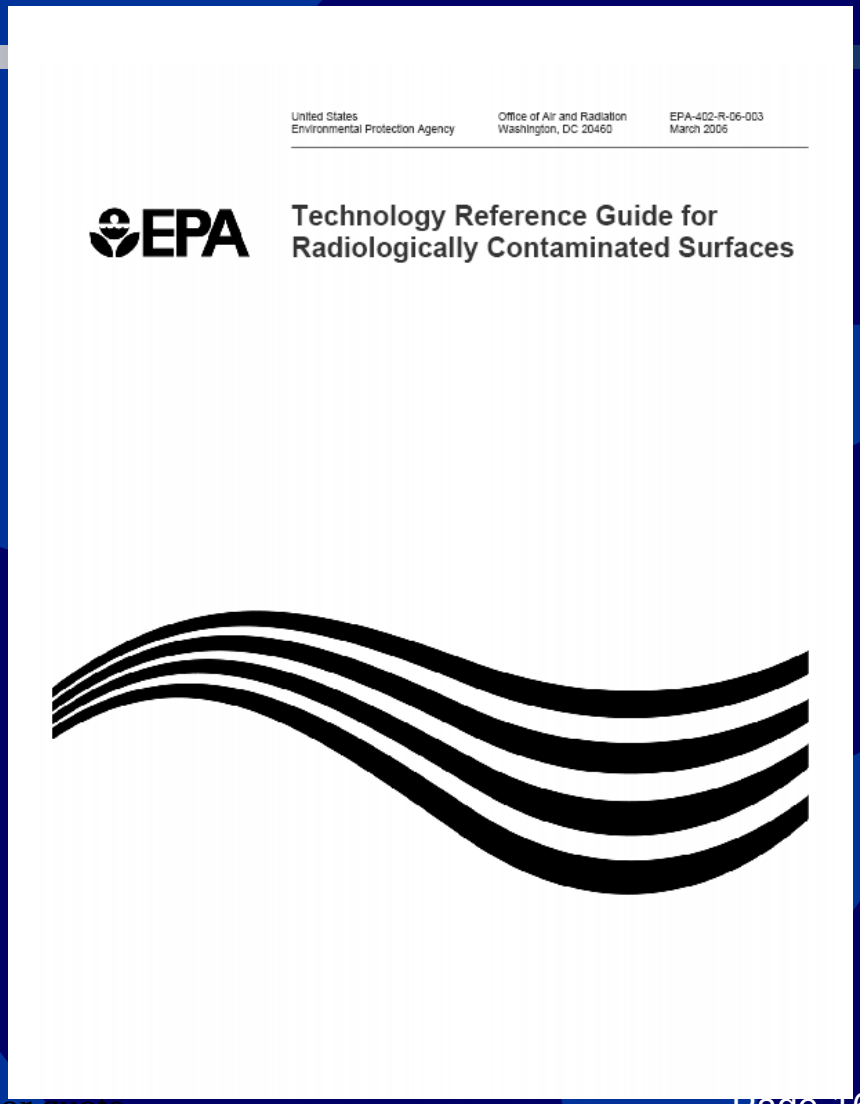
DHS - Team Coordination

- TWG works with the SWG so that local concerns can inform the work of the TWG
- TWG informs stakeholders of remediation options, feasibility, strengths and weaknesses
- Regular meetings of the RMT, SWG and TWG to
  - » facilitate consultation on site-specific goals, needs, and expectations
  - » share status of work products
  - » transmit findings
  - » discuss remediation options pros and cons
  - » share information on trends and developments

2.
Shortened Primer on Cleanup Approaches Considered in Today's Tabletop

Decontamination Technologies Primary Resource

- Chemical and Physical Technologies
  - » Description
  - » Target contaminates
  - » Applicable media
  - » Waste Streams
  - » Operating Characteristics
  - » Performance
  - » Operating Costs
  - » Commercial Availability
  - » Emerging Technologies



Materials in an Urban Environment

Material	%
Brick	30
Concrete	30
Asphalt	30
Glass/Metal	8
Wood / Treated	2

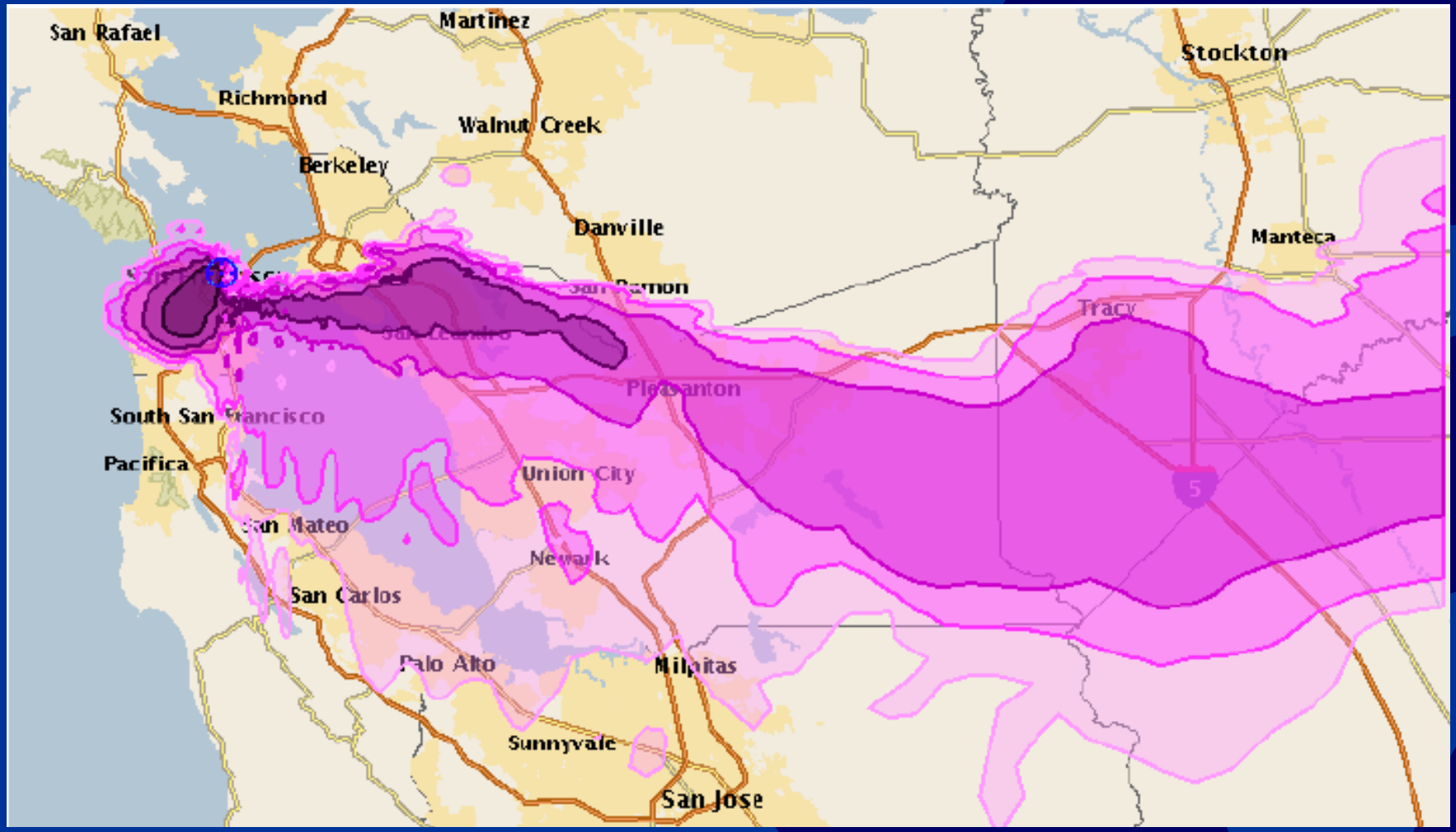
Source: LANL Report: LA-CP-03-0575

Canepa et al., 2003. Decontamination Efficiencies and Factors for Radioactive Contamination of Urban Environments

Decontamination Technologies – short list

- Common
  - Wash / pressure wash
  - Steam cleaning
  - Vacuum
- Physical
  - Strippable Coatings
  - Concrete Shaver
  - Media Blast Cleaning
- Chemical
  - TechXtract
- Other
  - Deep plowing / excavating
  - Road resurfacing / paving

3.
First scenario
RDD “Dirty Bomb” Scenario



Radiological Dispersal Devices (RDD)

- Both passive and active dispersion
- City or rural
- TTX RDD scenario
  - » 2,300 curies of Cesium-137
  - » 50 curies of Americium-241
  - » Based on combination of DHS and FAS scenarios

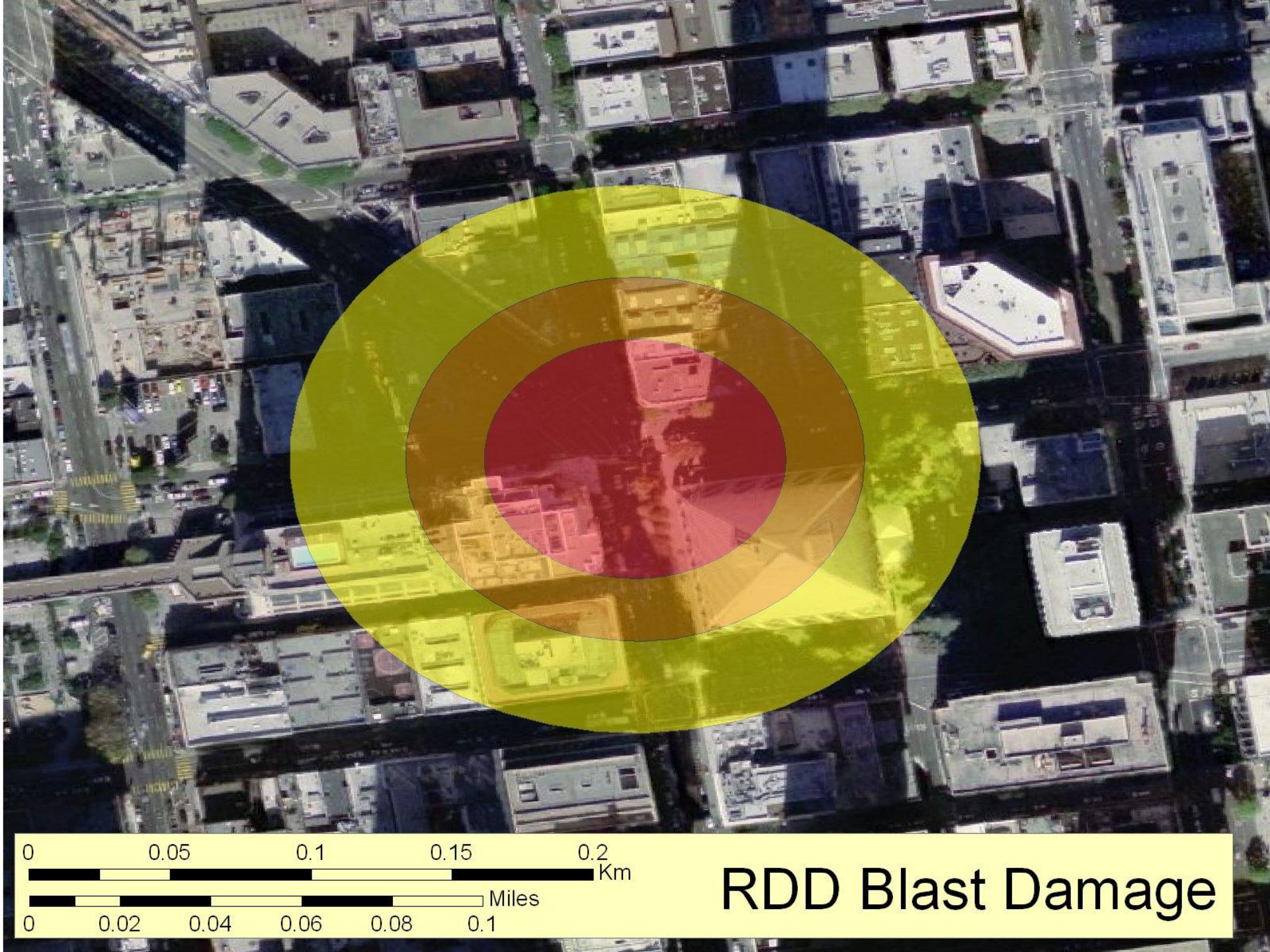
TTX RDD Impact

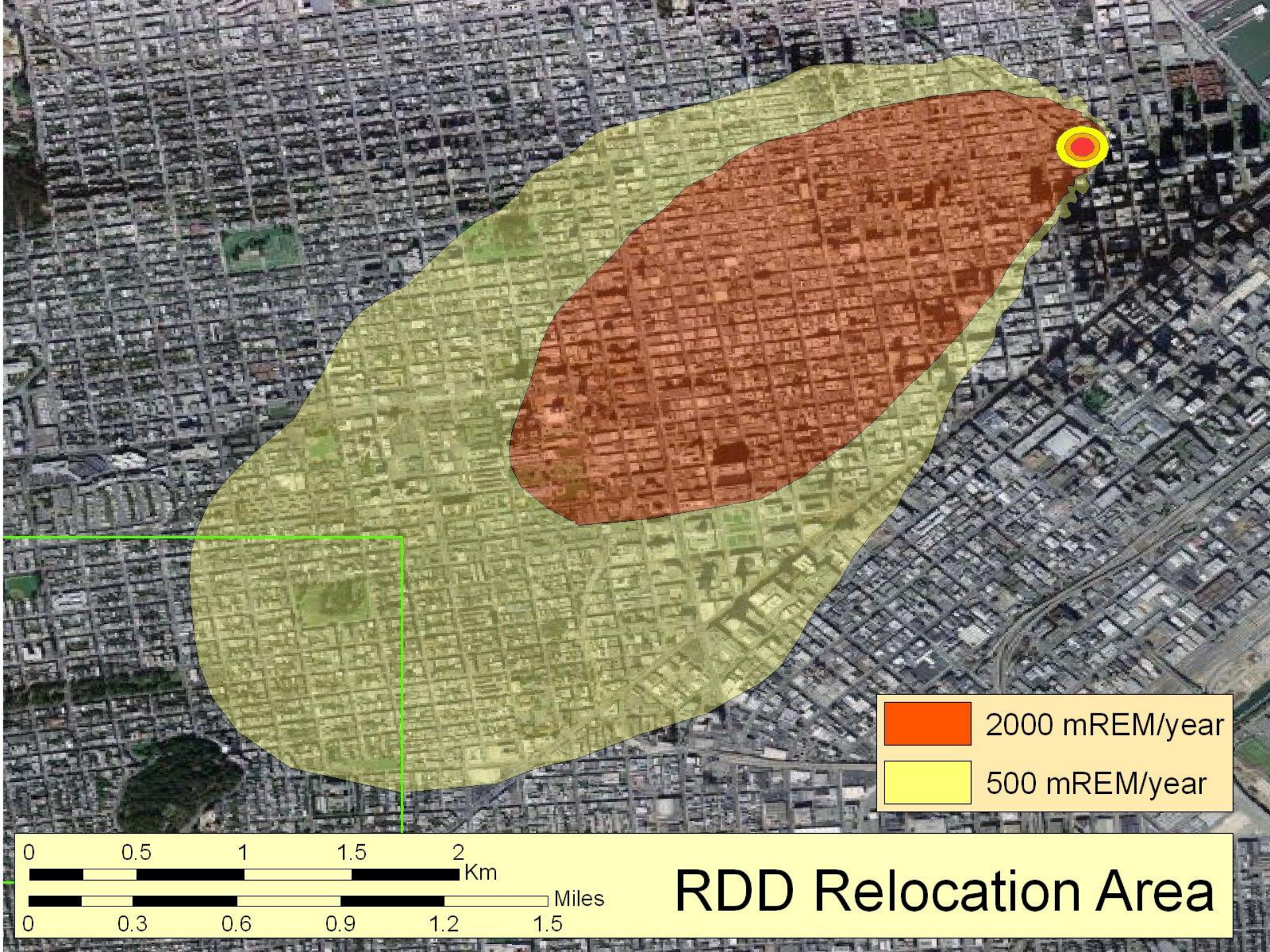
- 180 fatalities
- 270 injuries
- Relocation:
  - first year 79,200 persons
  - second year 139,000 persons
- Infrastructure damage limited to explosion
- Economic impact up to $billions

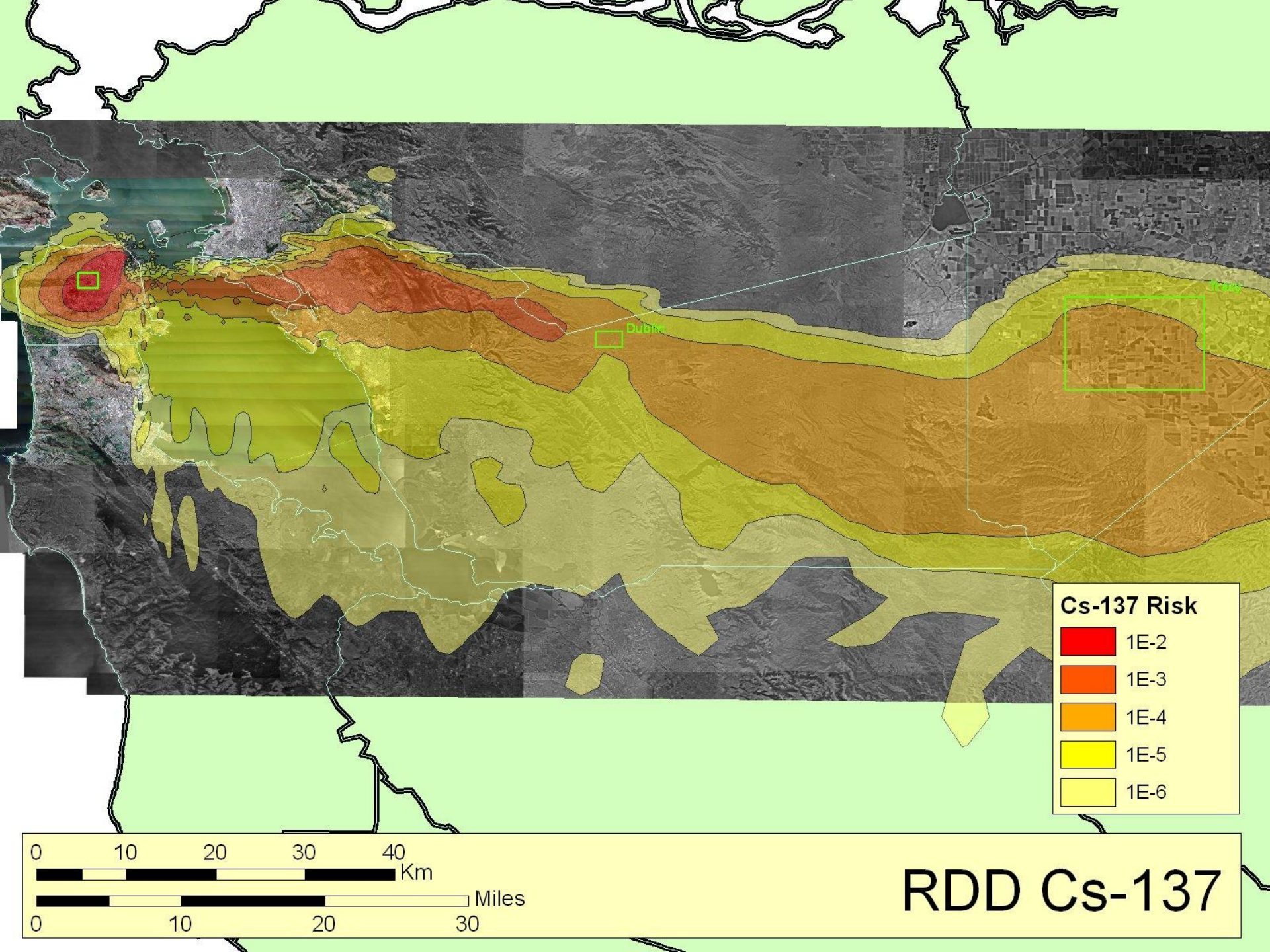
Extent of Contamination

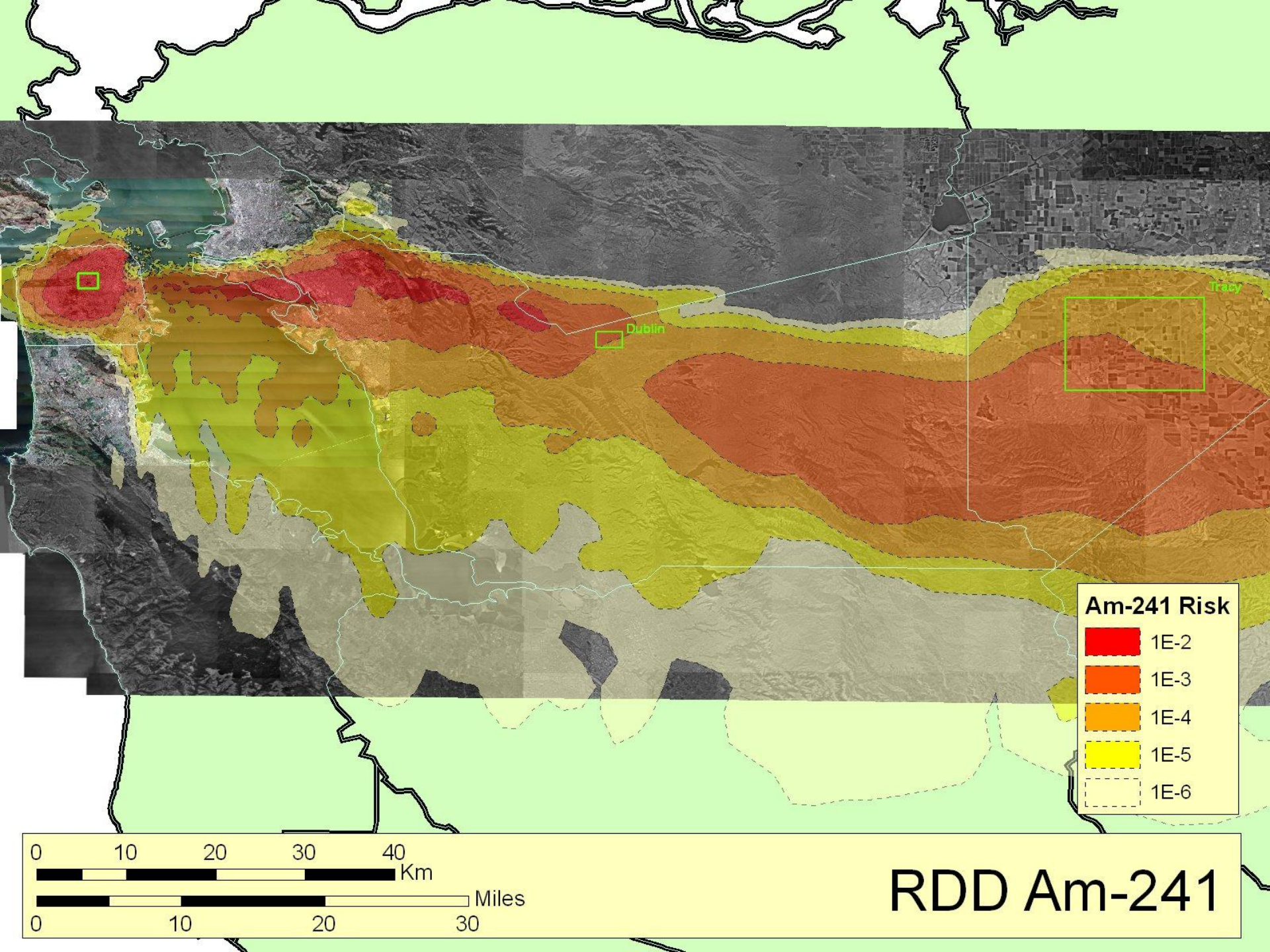
- 1st yr relocation PAG: 1.8 miles/1.2 square miles
- 2nd yr relocation PAG: 2.5 miles/2.6 square miles

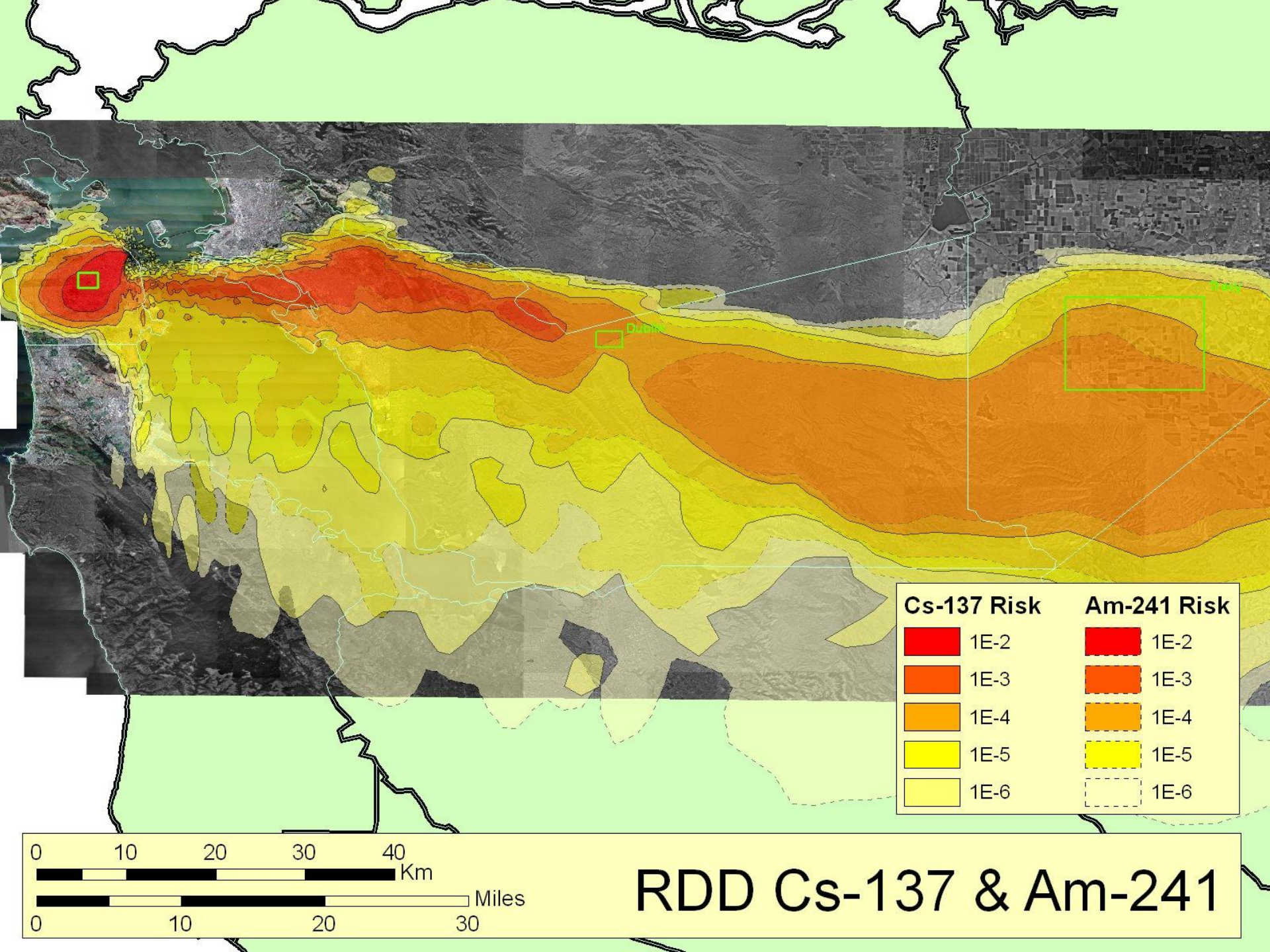
Risk Target	Distance (miles)	Area (sq miles)	Exposed (millions)
1×10^{-2}	24	59	0.608
1×10^{-3}	75	538	1.09
1×10^{-4}	75	1,147	1.62
1×10^{-5}	76	1,748	2.36
1×10^{-6}	85	2,633	3.91


0
0.05
0.1
0.15
0.2
Km
Miles
0
0.02
0.04
0.06
0.08
0.1
RDD Blast Damage


2000 mREM/year
500 mREM/year
0
0.5
1
1.5
2
Km
Miles
0
0.3
0.6
0.9
1.2
1.5
RDD Relocation Area


Dublin
Cs-137 Risk
1E-2
1E-3
1E-4
1E-5
1E-6
0
10
20
30
40
Km
Miles
0
10
20
30
RDD Cs-137


Dublin
Tracy
Am-241 Risk
1E-2
1E-3
1E-4
1E-5
1E-6
0 10 20 30 40
Km
Miles
0 10 20 30
RDD Am-241


Cs-137 Risk
1E-2
1E-3
1E-4
1E-5
1E-6
Am-241 Risk
1E-2
1E-3
1E-4
1E-5
1E-6
0 10 20 30 40
Km
Miles
0 10 20 30
RDD Cs-137 & Am-241

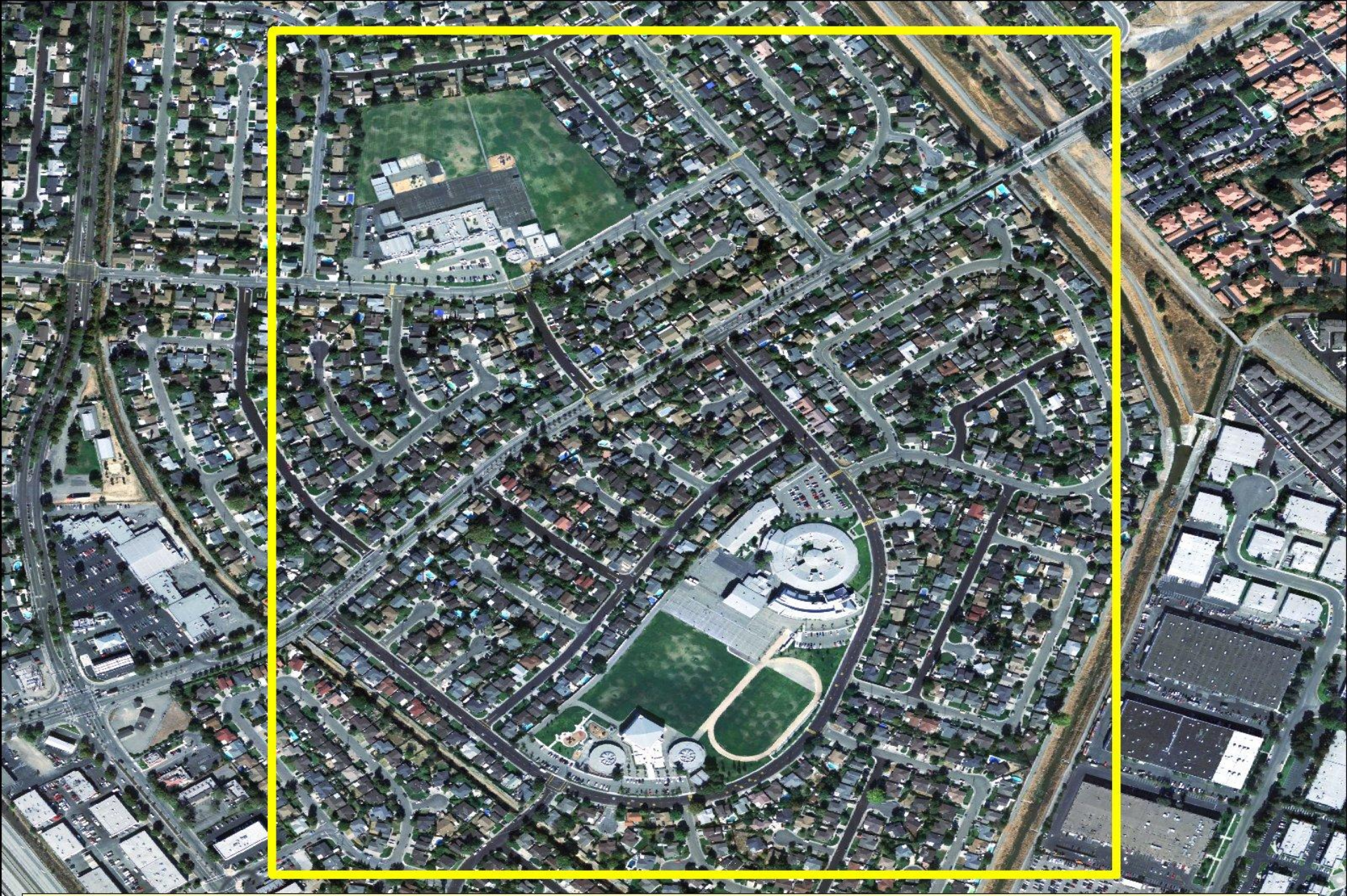
TTX Working Groups

- Urban – Haight Ashbury
- Suburban -- Dublin
- Agricultural/open space -- Tracy

Handouts

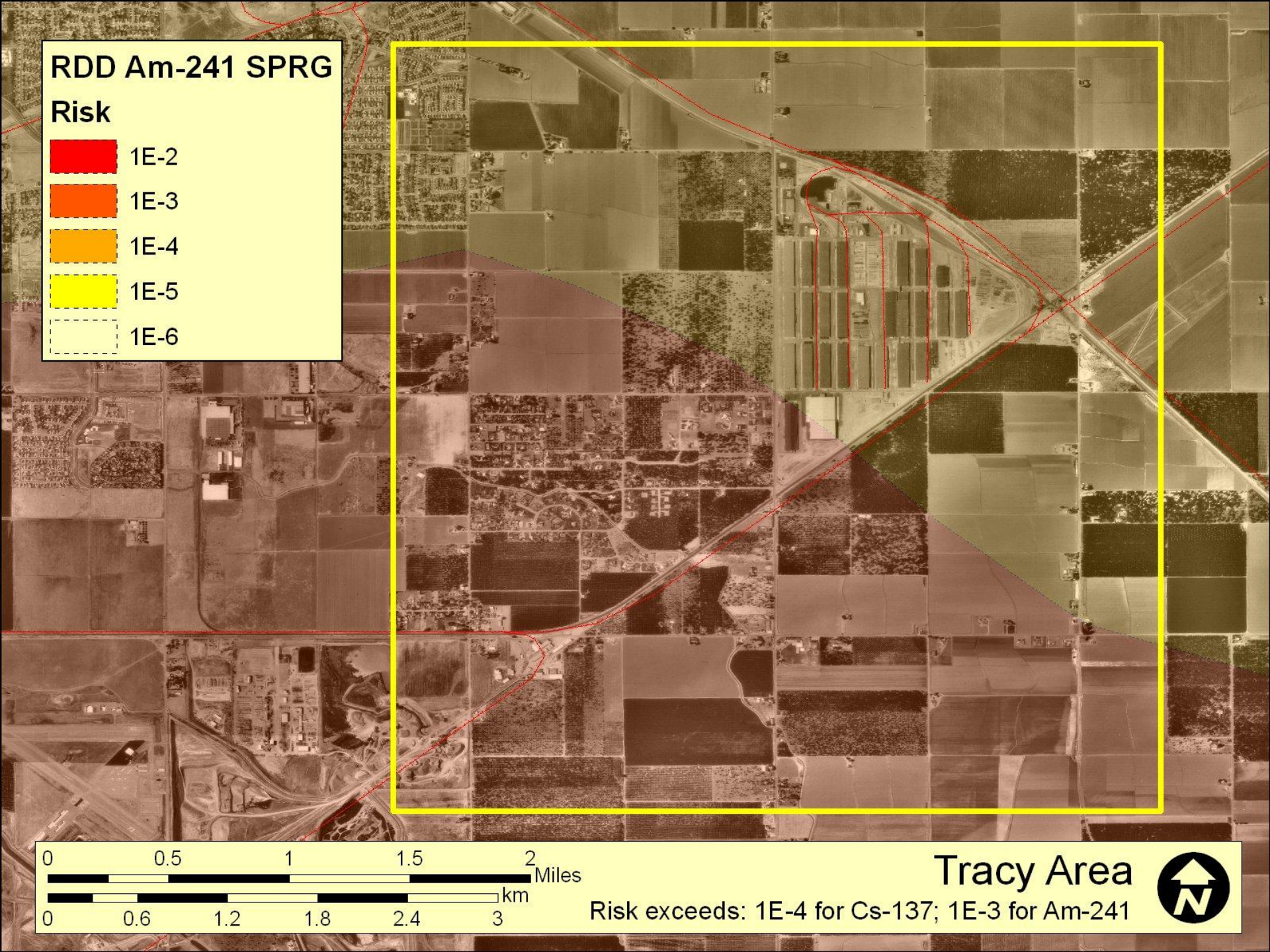
- Each TTX Workgroup got for their area:
  - Aerial Picture
  - RDD and IND Baseline risk assessment (36 exposure scenarios for 2 radionuclides)
  - Roadway classification Map
  - Remediation Technology Worksheet


RDD Relocation (2nd Year)
2000 mREM
500 mREM
0
0.1
0.2
0.3
0.4
Miles
km
0
0.1
0.2
0.3
0.4
0.5
Haight-Asbury Area
Risk exceeds: 1E-2 for Cs-137 & Am-241
N



Dublin Area

Risk exceeds: 1E-4 for Cs-137; 1E-3 for Am-241


RDD Am-241 SPRG
Risk
1E-2
1E-3
1E-4
1E-5
1E-6
0
0.5
1
1.5
2
Miles
0
0.6
1.2
1.8
2.4
3
km
Tracy Area
Risk exceeds: 1E-4 for Cs-137; 1E-3 for Am-241
N

RDD supporting material "RDD scenario risks Haight Ashbury ver 2.xls"

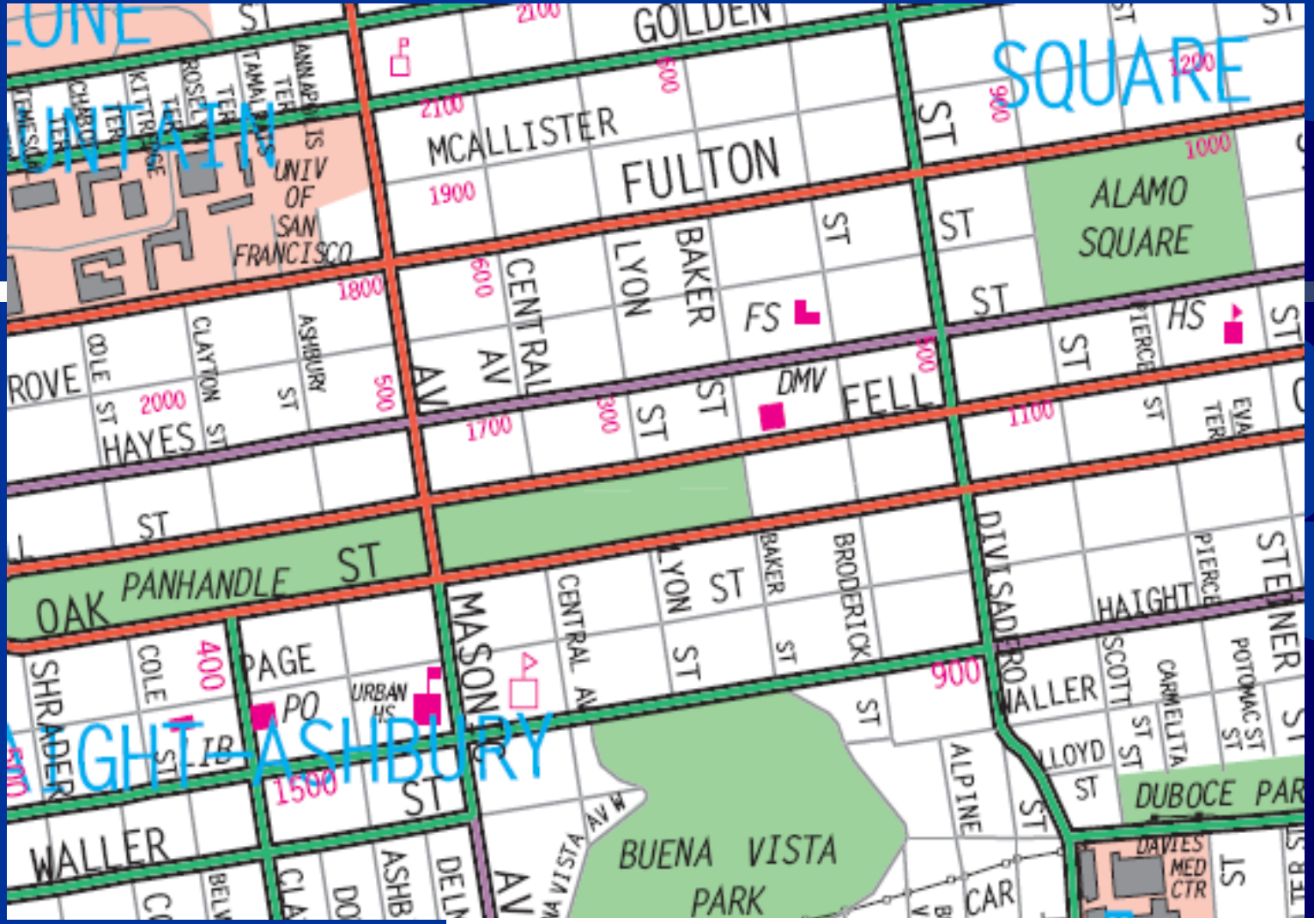
	SPRG Dust Concentration (pCi/cm^2) of 1E-06 Residential CA Urban local Rd PEFm [1]	SPRG Dust Concentration (pCi/cm2) of 1E-06 Outdoor Worker CA Urban local Rd PEFm [2]	SPRG Dust Concentration (pCi/cm2) of 1E-06 Indoor Worker CA Urban local Rd PEFm [3]	SPRG Dust Concentration (pCi/cm2) of 1E-06 Outdoor Worker PEFw [4]	SPRG Dust Concentration (pCi/cm^2) of 1E-06 Residential PEFw [5]	SPRG Dust Concentration (pCi/cm2) of 1E-06 Indoor Worker PEFw [6]
Americium-241	1.00E-04	4.89E-05	1.10E-04	6.39E-04	9.76E-04	1.38E-03
Cesium-137+D	3.58E-02	4.79E-02	5.75E-02	6.81E-02	3.99E-02	6.83E-02

	SPRG Dust Concentration (pCi/cm^2) of 1E-06 Residential CA Urban Other Principal Arterial PEFm [7]	SPRG Dust Concentration (pCi/cm2) of 1E-06 Outdoor Worker CA Urban Other Principal Arterial PEFm [8]	SPRG Dust Concentration (pCi/cm2) of 1E-06 Indoor Worker CA Urban Other Principal Arterial PEFm [9]	SPRG Dust Concentration (pCi/cm^2) of 1E-06 Residential CA Urban Minor Arterial PEFm [10]	SPRG Dust Concentration (pCi/cm2) of 1E-06 Outdoor Worker CA Urban Minor Arterial PEFm [11]	SPRG Dust Concentration (pCi/cm2) of 1E-06 Indoor Worker CA Urban Minor Arterial PEFm [12]
Americium-241	5.62E-07	2.71E-07	6.10E-07	1.11E-06	5.37E-07	1.21E-06
Cesium-137+D	1.72E-03	8.17E-04	1.81E-03	3.27E-03	1.60E-03	3.50E-03

	SPRG Dust Concentration (pCi/cm^2) of 1E-06 Residential CA Urban Collector PEFm [13]	SPRG Dust Concentration (pCi/cm2) of 1E-06 Outdoor Worker CA Urban Collector PEFm [14]	SPRG Dust Concentration (pCi/cm2) of 1E-06 Indoor Worker CA Urban Collector PEFm [15]	Default Concentration (pCi/cm^2) of 1E-06 Residential Fixed Contamination from SPRG 3-D [16]	Concentration (pCi/cm^2) of 1E-06 Outdoor Worker Fixed Contamination SPRG 3-D [17]	Concentration (pCi/cm^2) of 1E-06 Indoor Worker Fixed Contamination from SPRG 3-D [18]
Americium-241	2.23E-05	1.08E-05	2.42E-05	4.66E+00	9.01E+00	2.03E+01
Cesium-137+D	2.58E-02	2.24E-02	3.58E-02	2.84E-01	5.23E-01	1.18E+00

	PRG Soil Concentration (pCi/g) if local park/playground [19]	PRG Soil Concentration (pCi/g) if Resident Yard [20]	PRG Soil Concentration (pCi/g) if Outdoor Worker Yard [21]	PRG Soil Concentration (pCi/g) if Indoor Worker Yard [22]
Americium-241	2.05E+04	1.87E+00	5.73E+00	1.20E+01
Cesium-137+D	5.87E+00	5.97E-02	1.13E-01	2.53E-01

	BPRG Dust Concentration (pCi/cm^2) of 1E-06 Inside Unevacuated Bldg Residential [23]	BPRG Dust Concentration (pCi/cm^2) of 1E-06 Inside Unevacuated Bldg Indoor Worker [24]	BPRG Dust Concentration (pCi/cm^2) of 1E-06 Inside Evacuated Bldg Residential [25]	BPRG Dust Concentration (pCi/cm^2) of 1E-06 Inside Evacuated Bldg Indoor Worker [26]	BPRG Fixed 3-D Concentration (pCi/cm^2) of 1E-06 Inside Unevacuated Bldg Residential [27]	BPRG Fixed 3-D Concentration (pCi/cm^2) of 1E-06 Inside Unevacuated Bldg Indoor Worker [28]	BPRG Fixed 3-D Concentration (pCi/cm^2) of 1E-06 Inside Evacuated Bldg Residential [29]	BPRG Fixed 3-D Concentration (pCi/cm^2) of 1E-06 Inside Evacuated Bldg Indoor Worker [30]
Americium-241	3.48E-03	6.61E-02	3.48E-03	6.61E-02	1.20E+00	6.00E+00	1.20E+00	6.00E+00
Cesium-137+D	1.89E-02	9.68E-02	1.89E-02	9.68E-02	7.57E-02	3.62E-01	7.57E-02	3.62E-01



Haight-Ashbury

EPA

For Official Use Only:

Urban (Haight Ashbury) "Calculated Results ver6.xls"

Land Use/ building use		Sub Area extent	Total Extent	Technology Selected	Unit Cost	Rate (sq ft/hr)	Variable costs ($/sq ft) *	DF	Total Costs	Manpower / unit	Total Manhours	Unit Solid Waste	Total Solid Waste	Unit Liquid Waste	Total Liquid Waste
Building exteriors	Original	8057949		Concrete scabbling (1/4" deep)	$12,000	200	$2	200	$16,127,898	3	120869	3 / pass	#VALUE!		0
	Post Cleanup														
Res. Interiors (evacuated)	Original	98230887		ALARA 1146 Strippable coating	$0	133	$5	7	$476,419,802	3	2215734	0.25 / coat	#VALUE!		0
	Post Cleanup														
Res. Interiors (non-evac)	Original	229205406		Concrete scabbling (1/4" deep)	$12,000	200	$2	200	$458,422,812	3	3438081	3 / pass	#VALUE!		0
	Post Cleanup														
Ind. Interiors (evacuated)	Original	13165199		Media blasting	$12,000	100	$5	100	$60,571,915	3	394956	0.75 / pass	#VALUE!		0
	Post Cleanup														
Ind. Interiors (non-evac)	Original	30718790		ALARA 1146 Strippable coating	$0	133	$5	7	$148,986,132	3	692905	0.25 / coat	#VALUE!		0
	Post Cleanup														
Local Parks/	Original	1622121		Deep plowing	$50,000	43560	$0	10	$51,117	1	37	0	0		0
	Post Cleanup														
Lawns	Original	1139252		Soil excavation (skim)	$50,000	13068	$0	10	$51,831	2	174	18.37	20928059		0
	Post Cleanup														
Local streets	Original	1940701		ALARA 1146 Strippable coating	$0	133	$5	7	$9,412,400	3	43775	0.25 / coat	#VALUE!		0
	Post Cleanup														
Highways	Original			ALARA 1146 Strippable coating	$0	133	$5	7	$0	3	0	0.25 / coat	#VALUE!		0
	Post Cleanup														
Drives and parking lots	Original	336491		Road resurface (pave over)	$200,000	1015	$1	na	$671,087	10	3315	0	0		0
	Post Cleanup														
Totals	Original								$1,170,714,994				#VALUE!		0
	Post Cleanup														

Exercise Outcome: Create TWG Recommendations to the DT

Pre-Event Land Use: _____

	Recommended Actions	Rationale
Description of cleanup Area		
Final Land Use(s)		
Proposed Risk Level		
Cleanup Levels for Am-241		
Cleanup Levels for Cs-137		
Cleanup technologies		
Timeframe/phasing for Cleanup		
Proposed Land Use(s) During Cleanup (if different)		
Costs		

4.
Today's second scenario
IND Scenario

Improvised Nuclear Device (IND) Scenario

- Homemade or stolen nuclear device
- 10 Kt full yield
- Late-phase cleanup focuses on Cesium-137 and Strontium-90

Impact

- 229,900 fatalities
- 317,400 injuries
- Evacuation: 1.16 to 2.11 million persons
- Relocation:
  - » first year 1.22 million persons,
  - » second year 521,000 persons
- Infrastructure damage total with 0.5 to 3 miles
- Economic impact up to $hundreds of billions

Extent of Contamination

- 1st yr relocation PAG: 175 miles/1,420 square miles
- 2nd yr relocation PAG: 54 miles/171 square miles

Risk Target	Distance (miles)	Area (sq miles)	Exposed (millions)
1×10^{-2}	60	267	0.631
1×10^{-3}	235	2,590	1.35
1×10^{-4}	237	5,767	1.80
1×10^{-5}	238	9,468	2.52
1×10^{-6}	240	16,362	3.68


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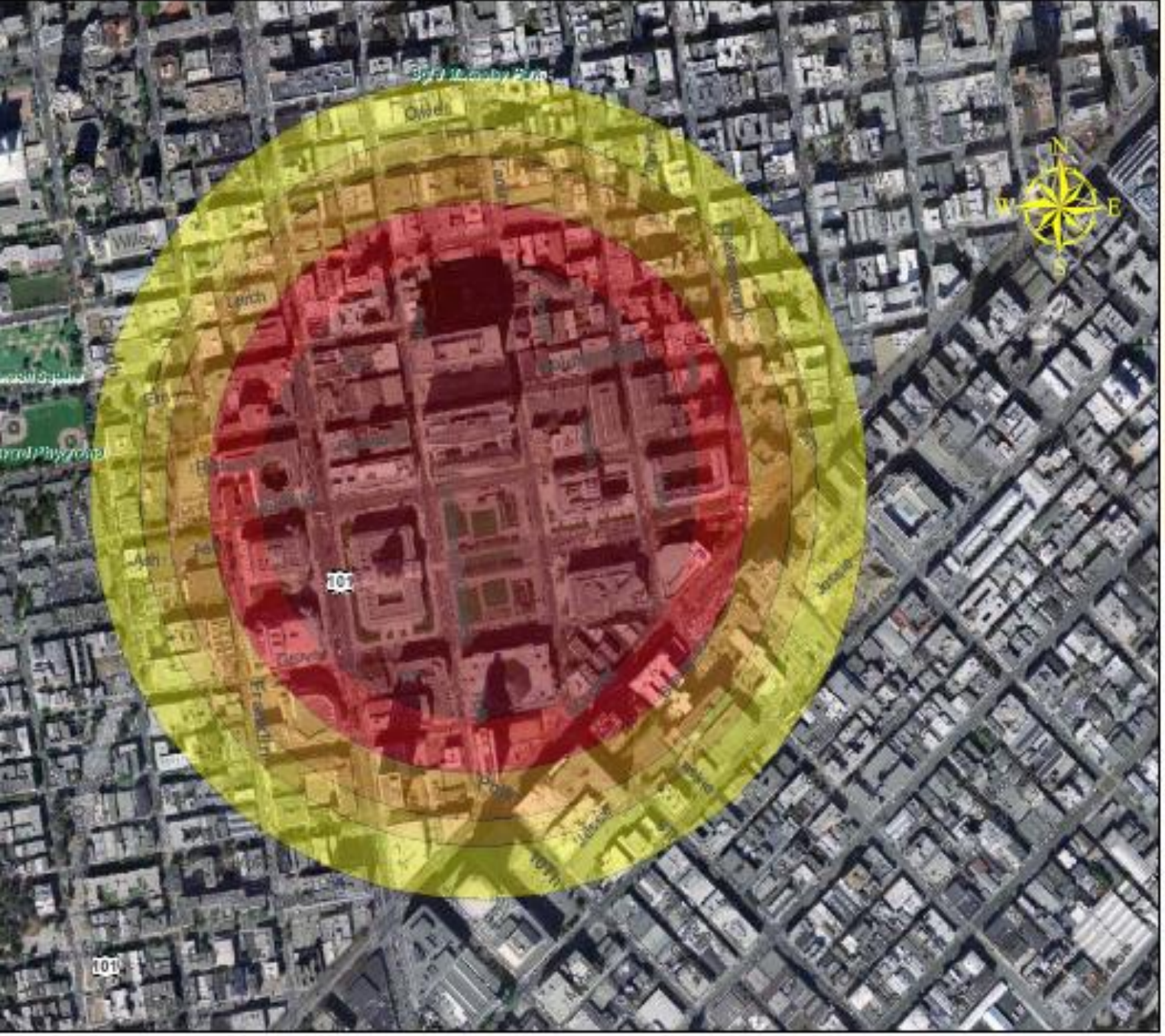
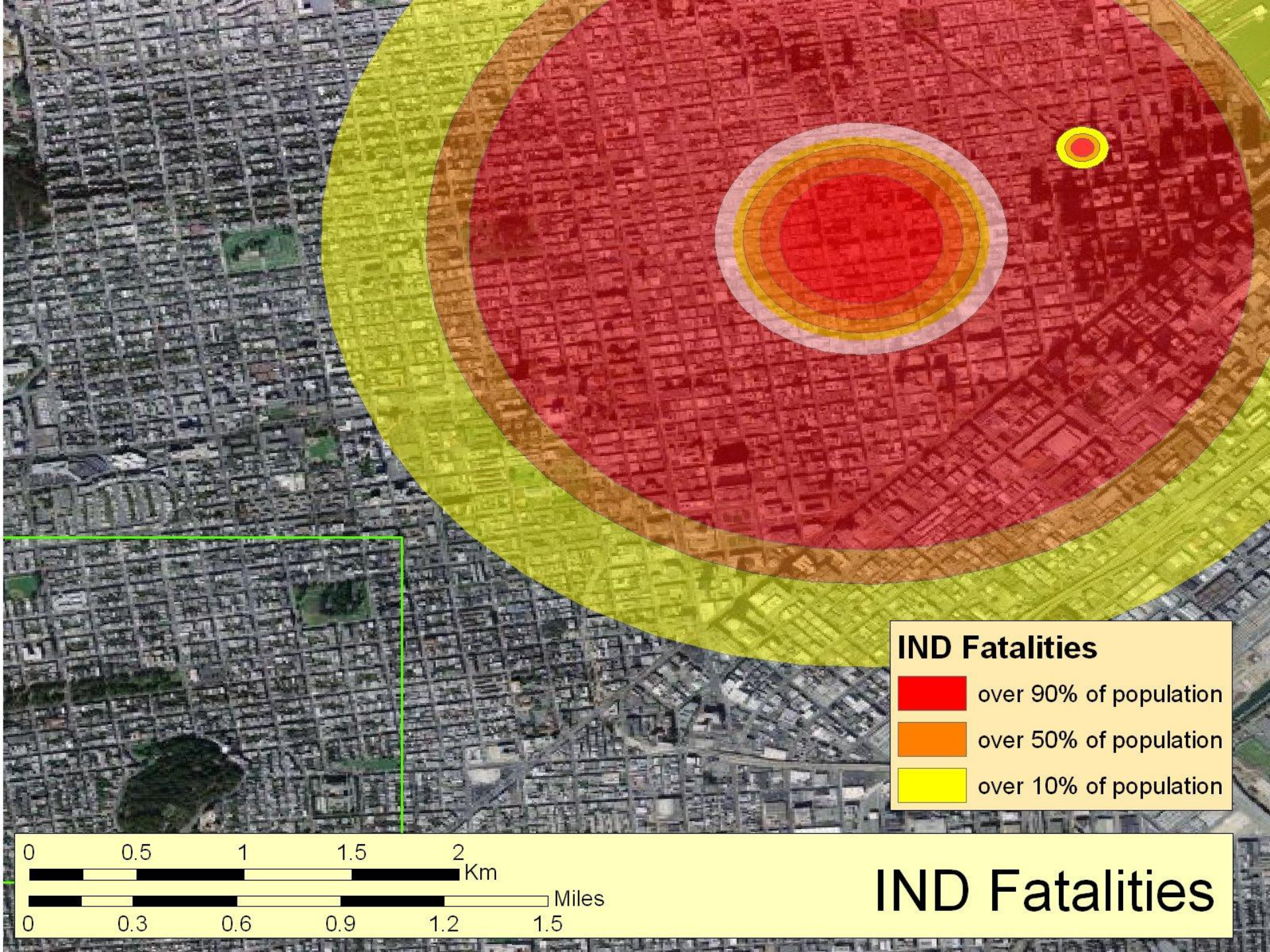
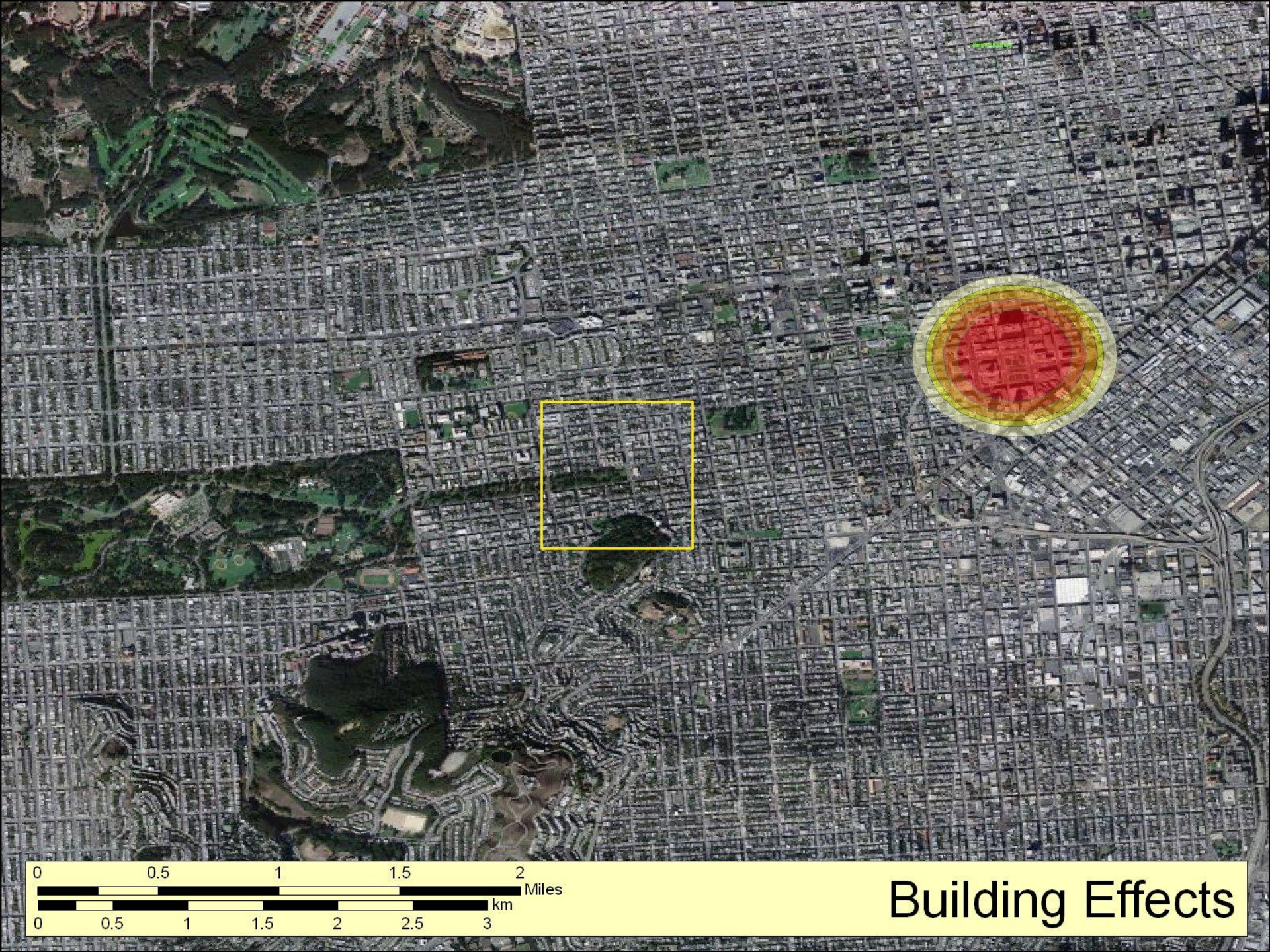
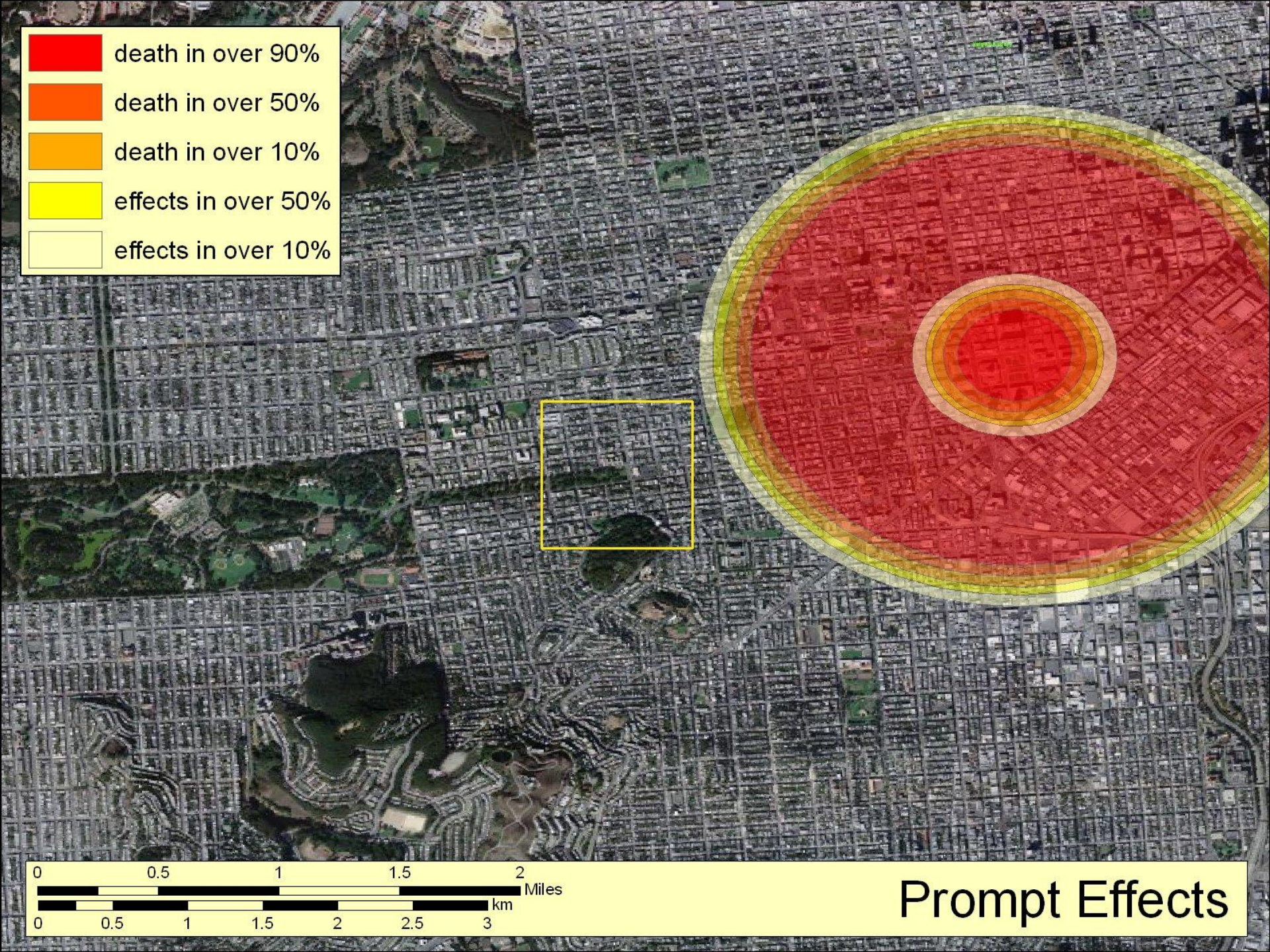
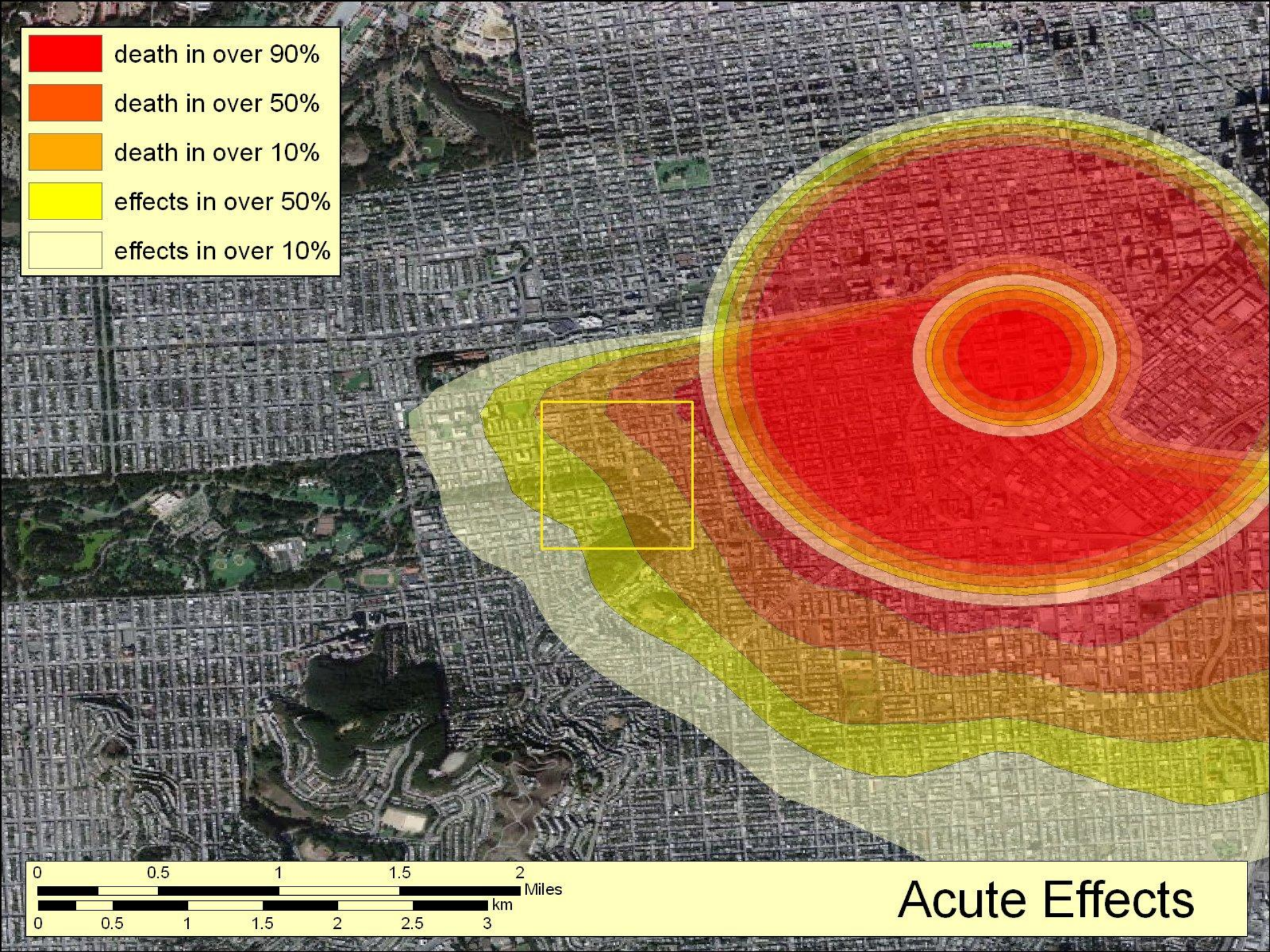
Image © 2007 TerraMetrics
Google

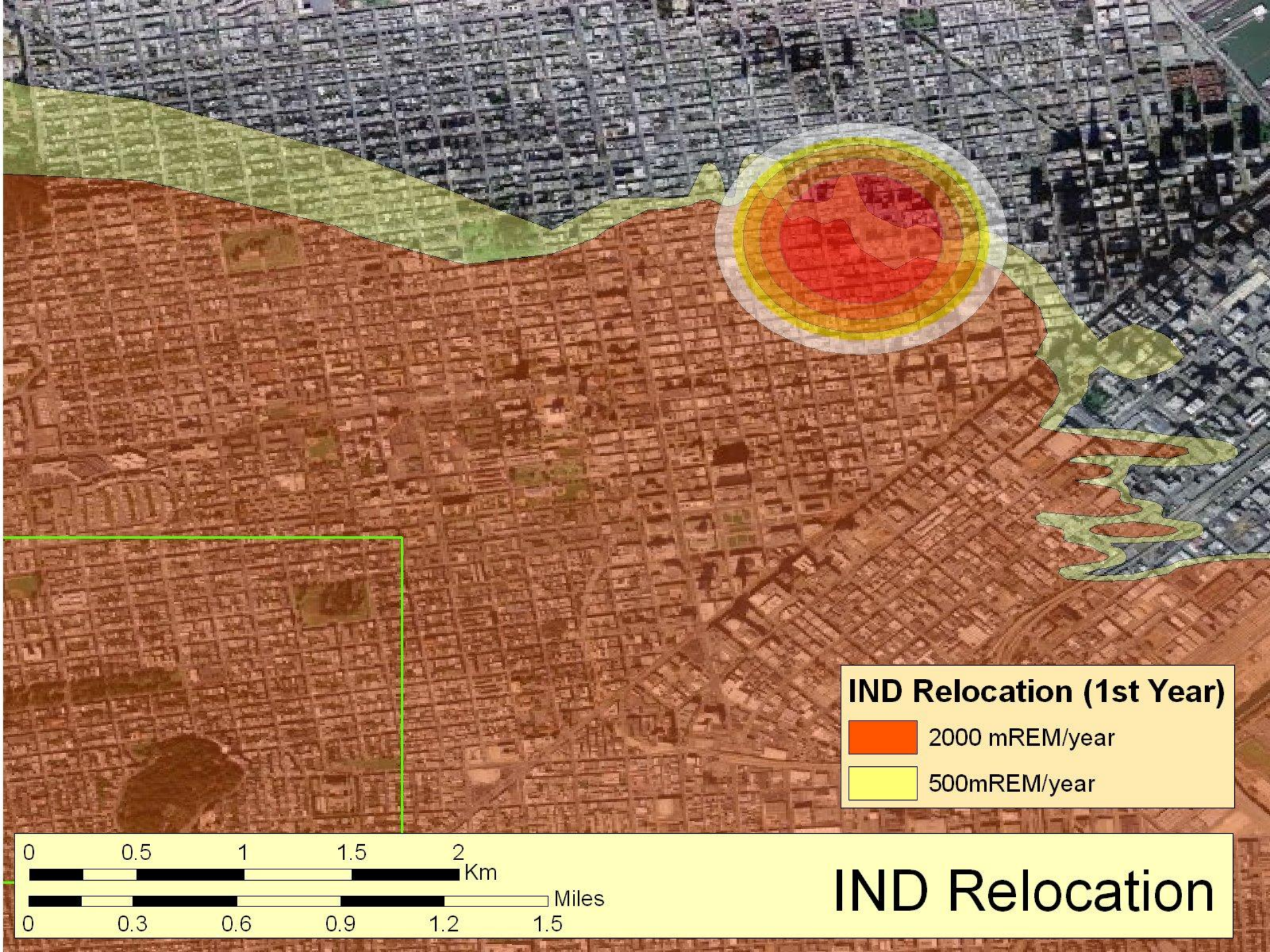

Legend
Prompt Overpressure Bldg Effects
> 54.7 psi
Severe damage to over 90%
of Heavy Buildings.
> 33.5 psi
Severe Damage to over 50%
of Heavy Buildings.
> 24.2 psi
Moderate Damage to over 50%
of Heavy Buildings.
> 20.5 psi
Severe Damage to over 10%
of Heavy Buildings.
> 15.5 psi
Moderate Damage to over 10%
of Heavy Buildings.
N
W
E
S
101
101
0
0.1
0.2
0.4
0.6
0.8
Miles

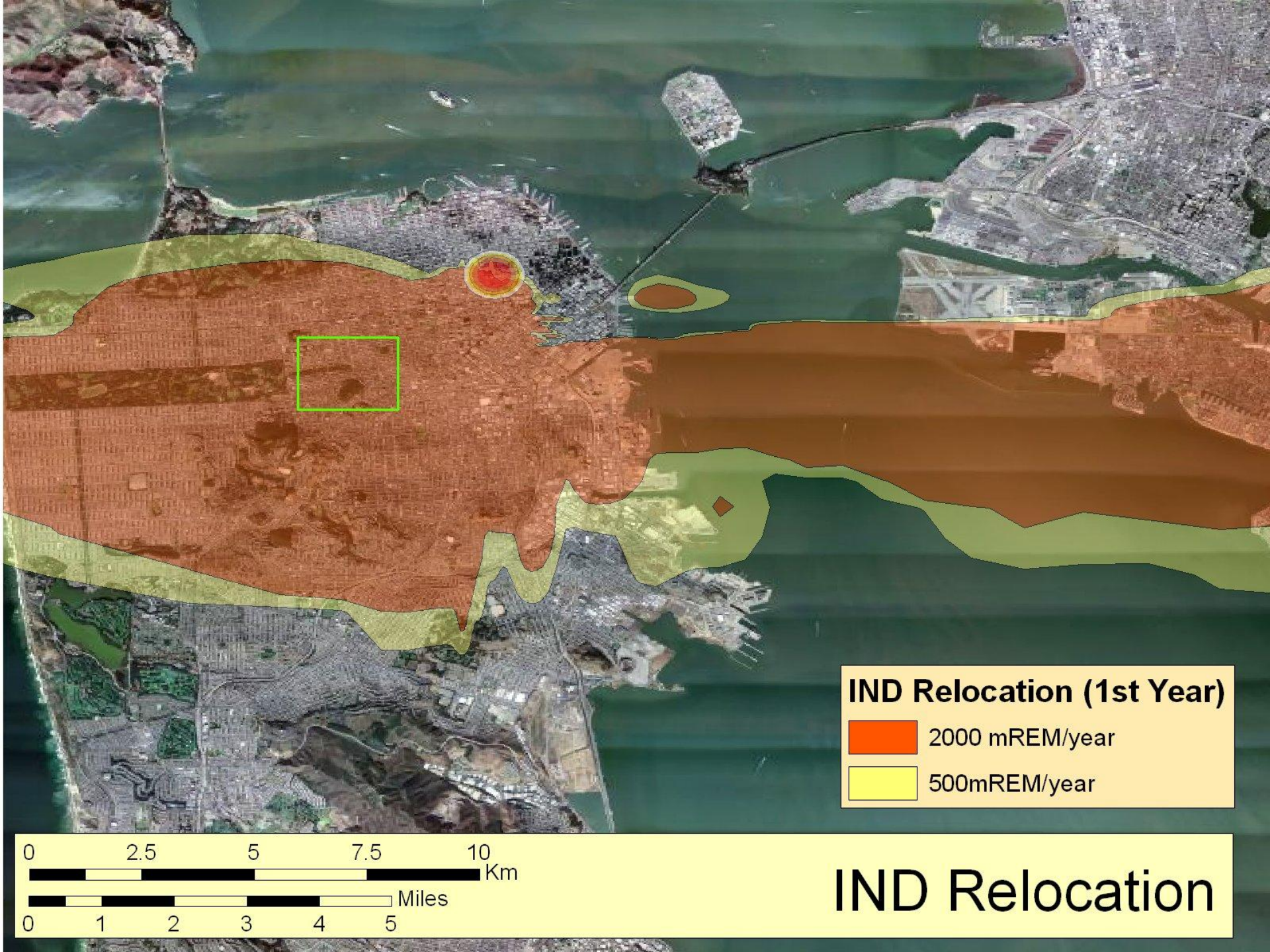

IND Fatalities
over 90% of population
over 50% of population
over 10% of population
0
0.5
1
1.5
2
Km
Miles
0
0.3
0.6
0.9
1.2
1.5
IND Fatalities

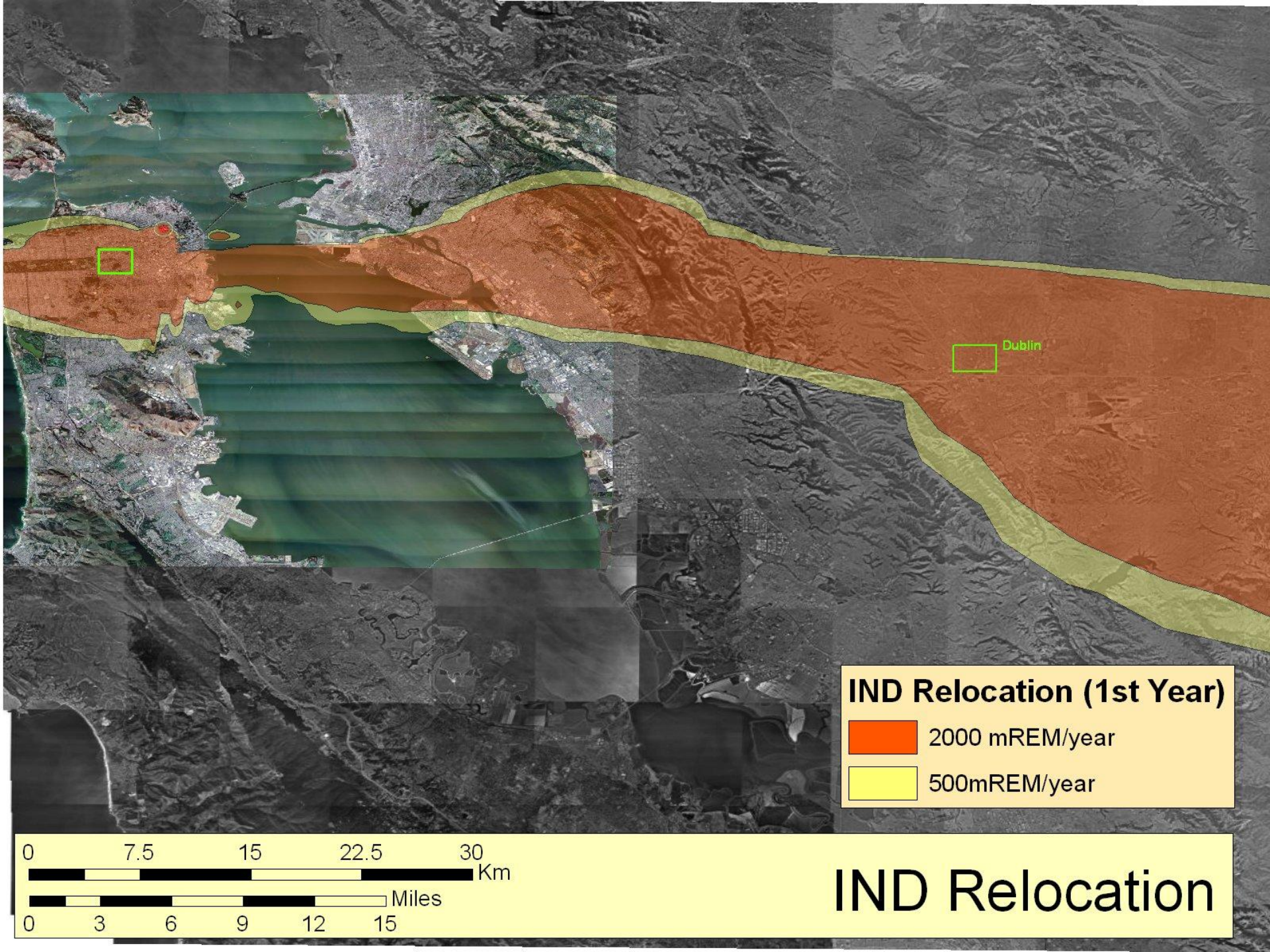

0
0.5
1
1.5
2
Miles
km
0
0.5
1
1.5
2
2.5
3
Building Effects

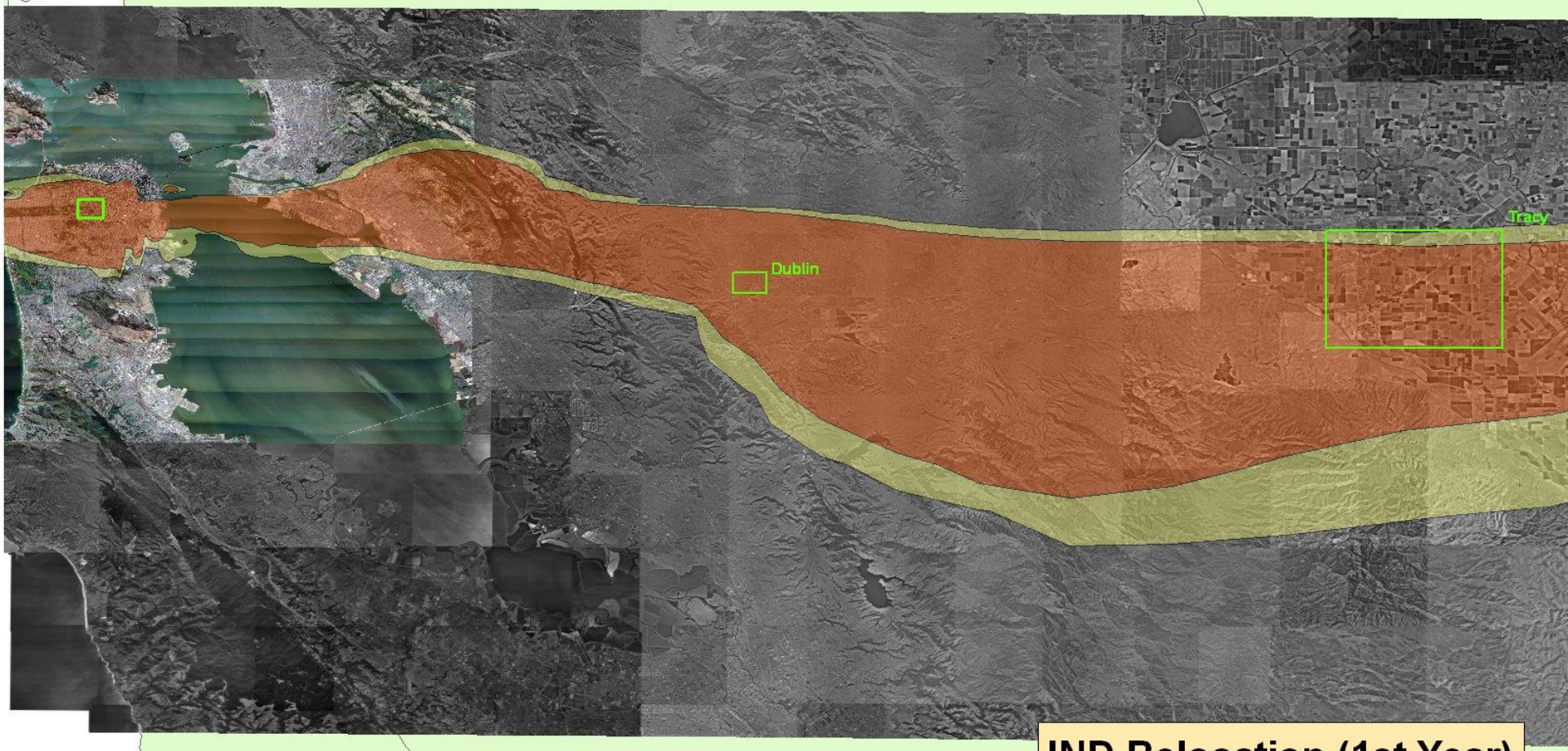

death in over 90%
death in over 50%
death in over 10%
effects in over 50%
effects in over 10%
0
0.5
1
1.5
2
Miles
km
0
0.5
1
1.5
2
2.5
3
Prompt Effects


death in over 90%
death in over 50%
death in over 10%
effects in over 50%
effects in over 10%
0
0.5
1
1.5
2
Miles
km
0
0.5
1
1.5
2
2.5
3
Acute Effects


IND Relocation (1st Year)
2000 mREM/year
500mREM/year
0
0.5
1
1.5
2
Km
Miles
0
0.3
0.6
0.9
1.2
1.5
IND Relocation


IND Relocation (1st Year)
2000 mREM/year
500mREM/year
0
2.5
5
7.5
10
Km
Miles
0
1
2
3
4
5
IND Relocation


Dublin
IND Relocation (1st Year)
2000 mREM/year
500mREM/year
0
7.5
15
22.5
30
Km
Miles
0
3
6
9
12
15
IND Relocation



IND Relocation (1st Year)

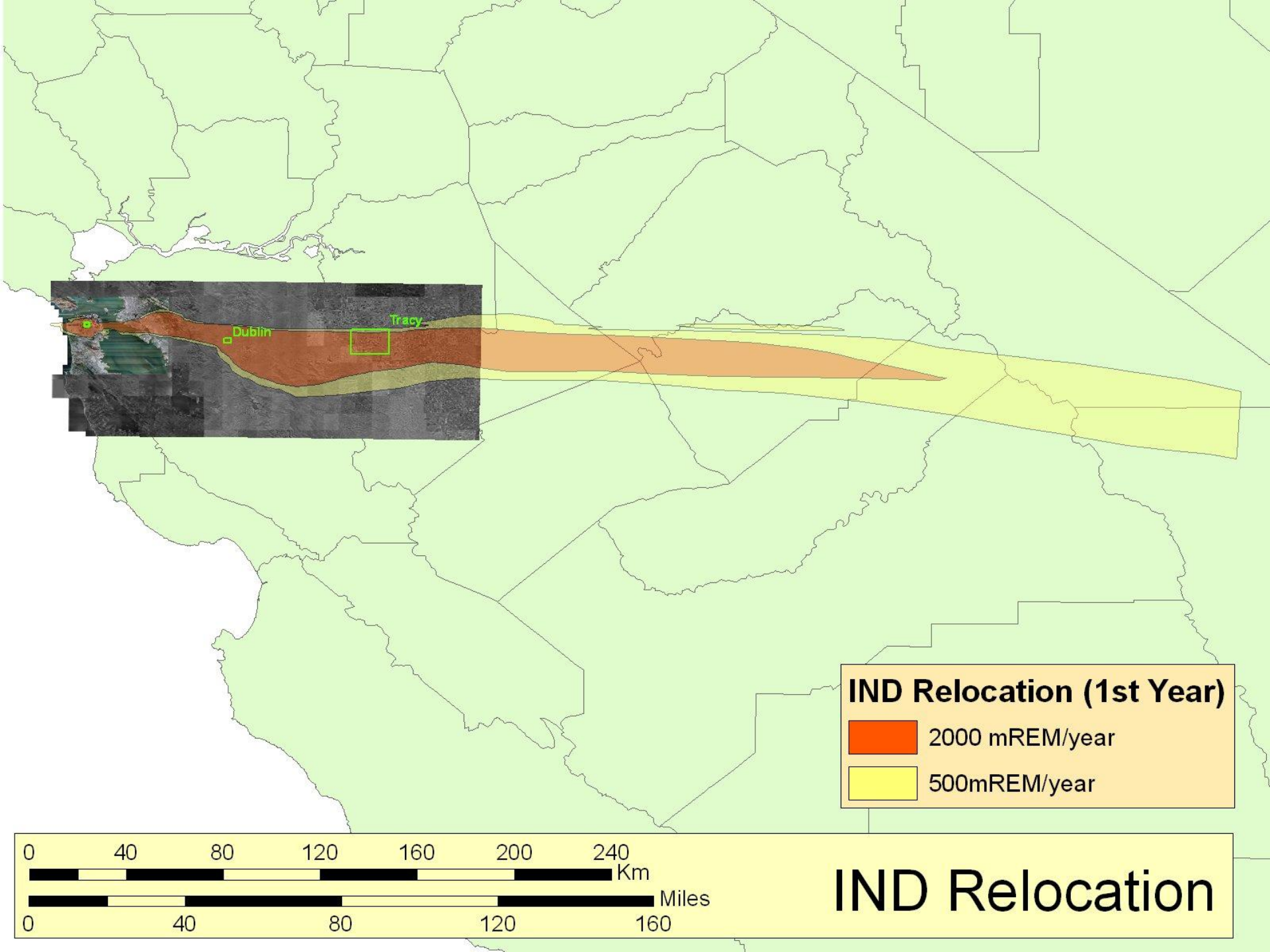
2000 mREM/year

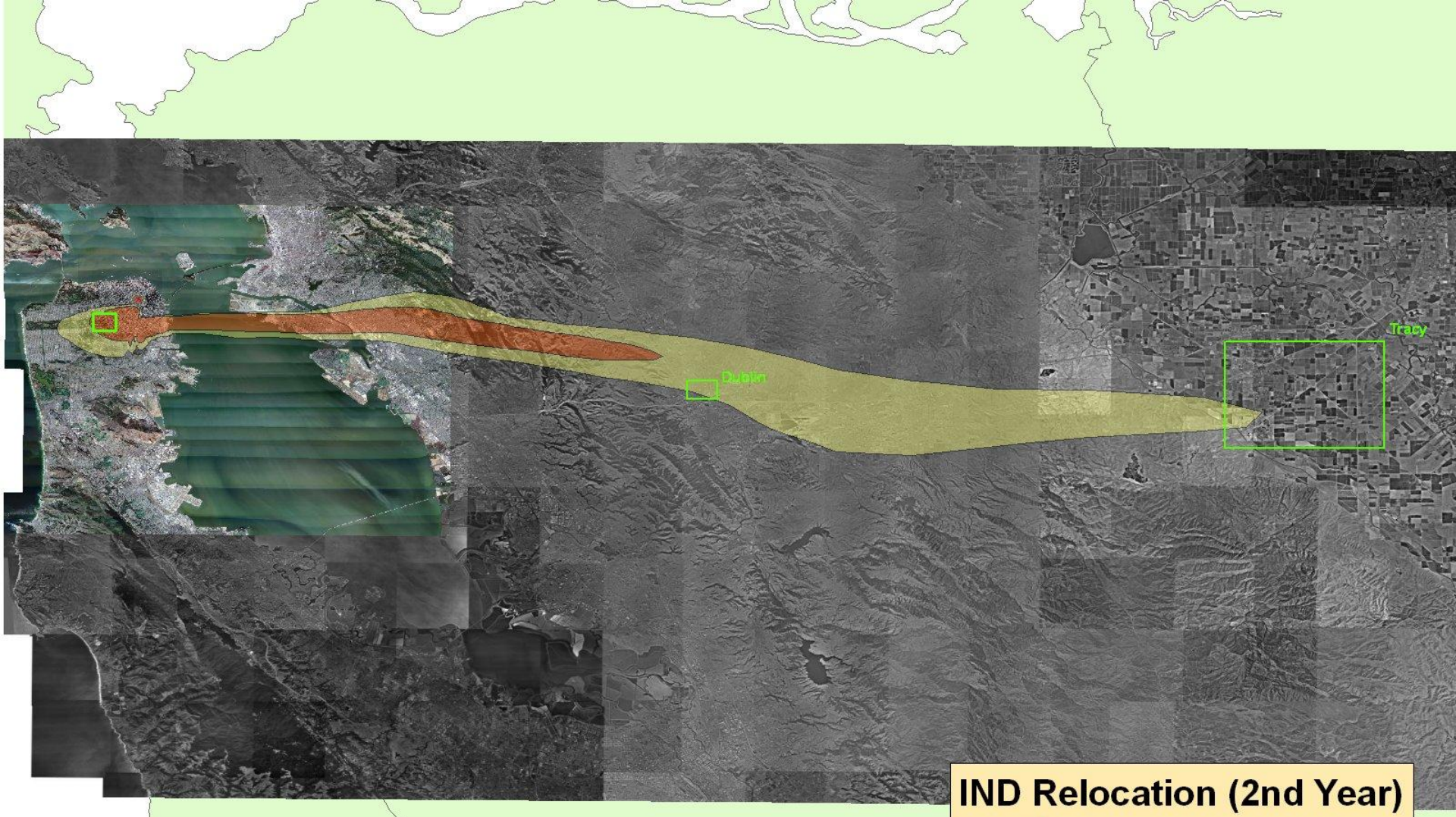
500mREM/year

0 10 20 30 40 50 60 Km

0 10 20 30 40 Miles

IND Relocation


Dublin
Tracy
IND Relocation (1st Year)
2000 mREM/year
500mREM/year
0
40
80
120
160
200
240
Km
Miles
0
40
80
120
160
IND Relocation



IND Relocation (2nd Year)

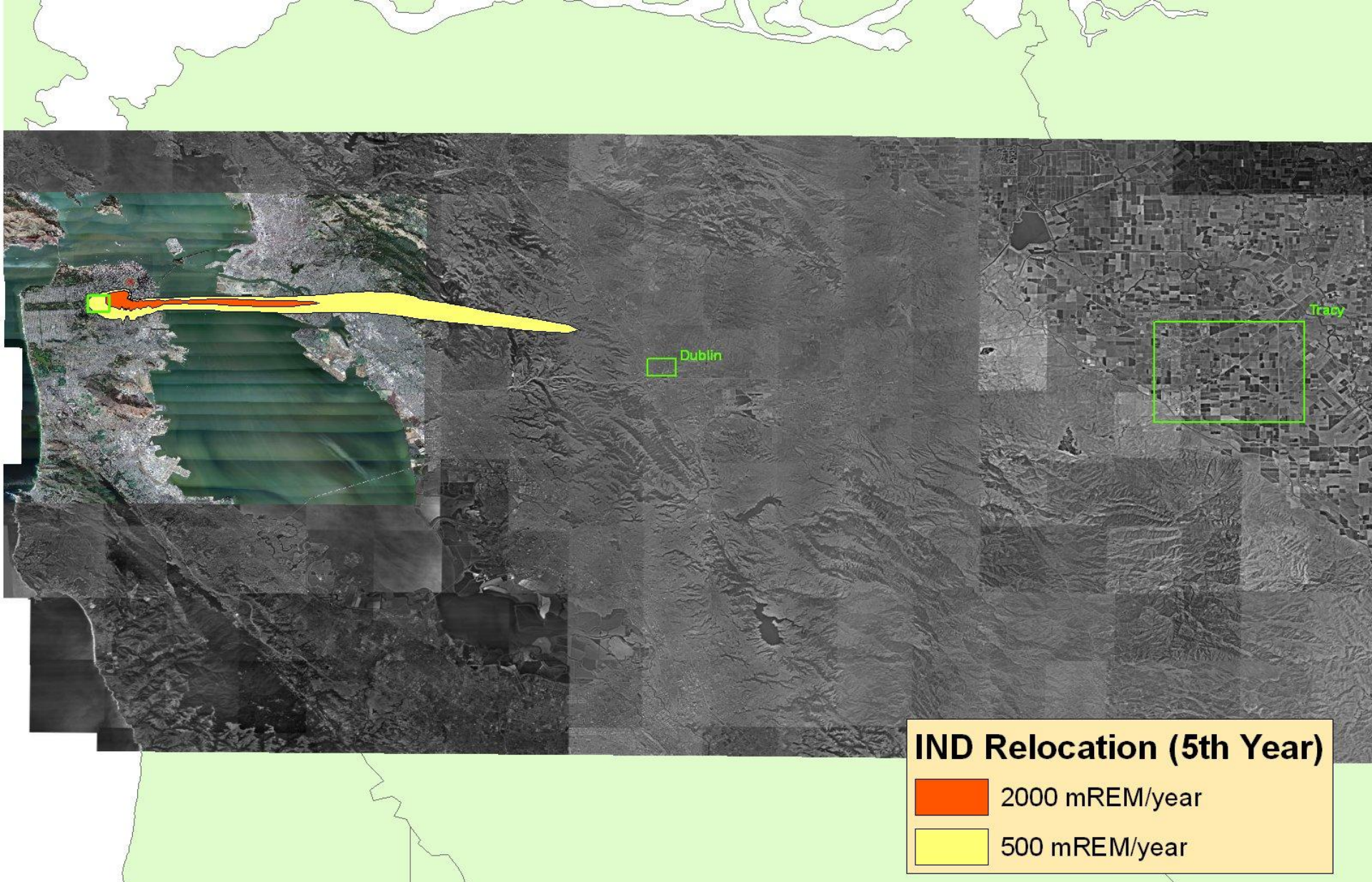
2000 mREM/year

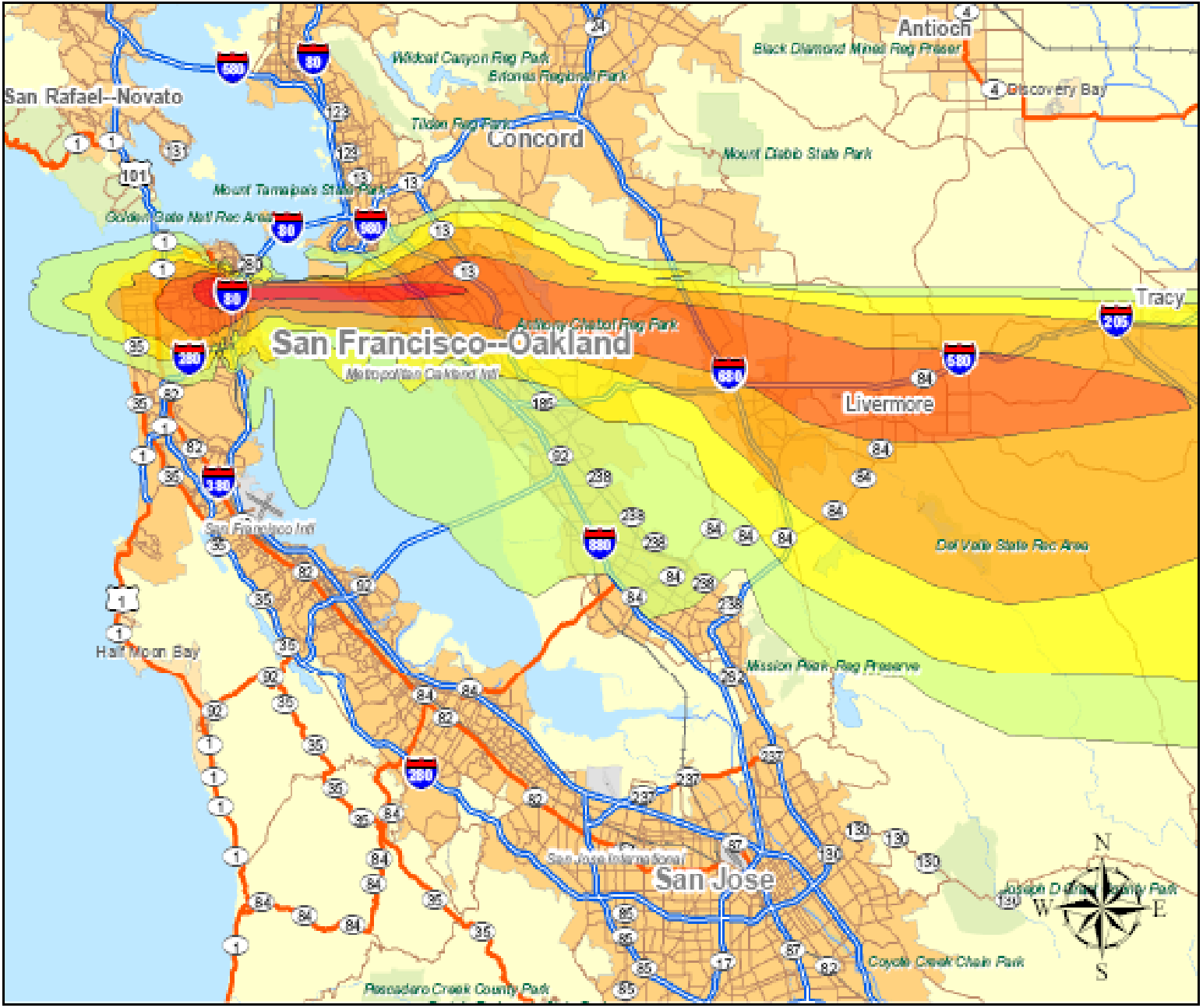
500 mRem/year

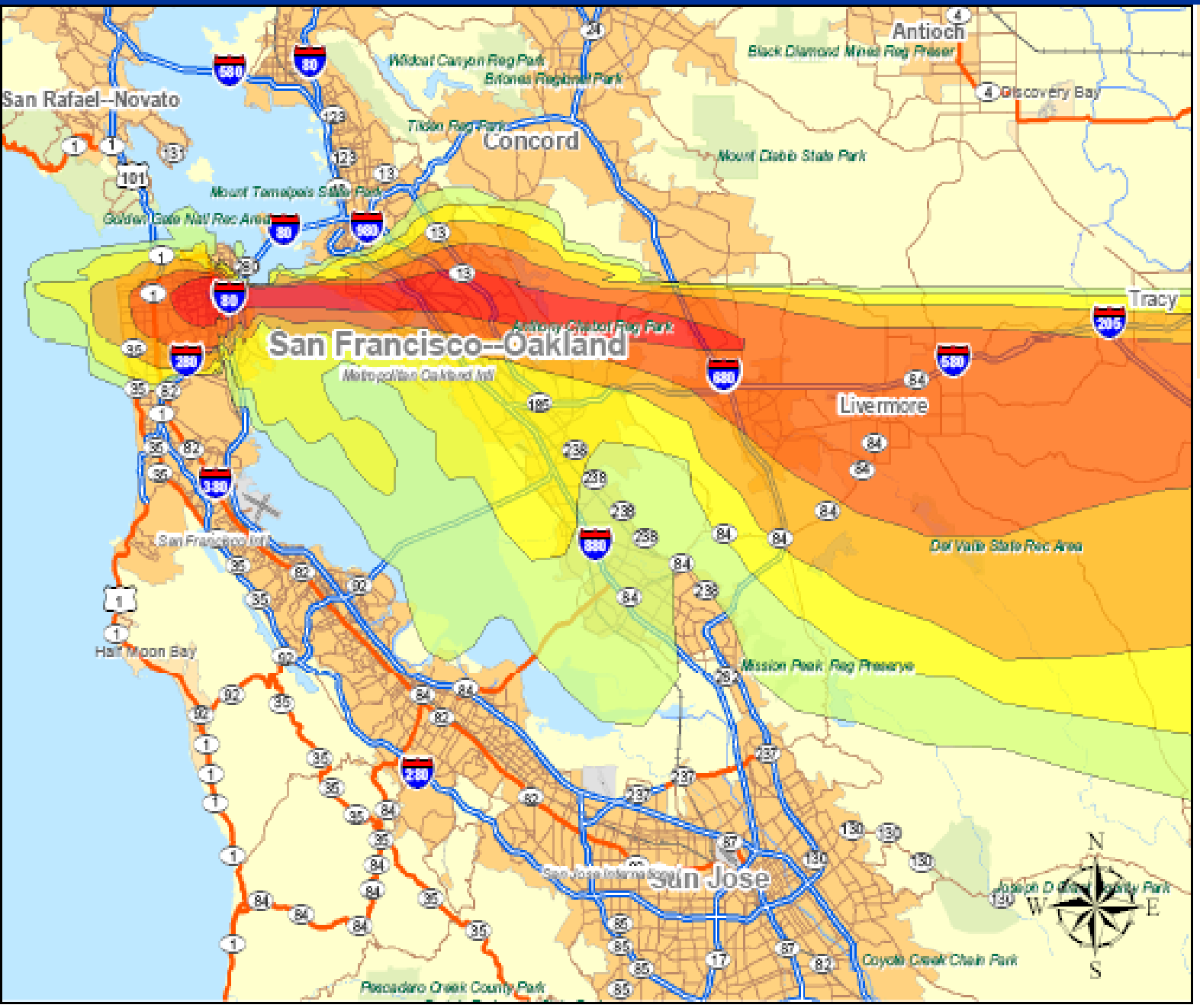
0 8 16 24 32 40 48 Km

0 8 16 24 32 Miles

IND Relocation


Dublin
Tracy
IND Relocation (5th Year)
2000 mREM/year
500 mREM/year
0
10
20
30
40
50
Km
Miles
0
10
20
30
40
IND Relocation


Legend
CS-137 + daughters
Residential SPRG
> 4.0 uCi/m2
> 0.4 uCi/m2
> 0.04 uCi/m2
> 0.004 uCi/m2
> 0.0004 uCi/m2
San Francisco--Oakland
San Jose
Concord
Livermore
Tracy
Antioch
San Rafael--Novato
Half Moon Bay
Discovery Bay
Mount Diablo State Park
Del Valle State Rec Area
Mission Peak Reg Preserve
Coyote Creek Chain Park
Pescadero Creek County Park
N
S
E
W
0
5
10
20
30
40
Miles


Legend
Sr-90 + daughters
Residential SPRG
> 1.0 uCi/m2
> 0.1 uCi/m2
> 0.01 uCi/m2
> 0.001 uCi/m2
> 0.0001 uCi/m2
San Rafael--Novato
Concord
Antioch
Discovery Bay
Tracy
San Francisco--Oakland
Livermore
San Jose
Half Moon Bay
Mount Tamalpais State Park
Mount Diablo State Park
Del Valle State Rec Area
Mission Peak Reg Preserve
Coyote Creek Chain Park
Pescadero Creek County Park
0 5 10 20 30 40
Miles

Legend

Cs-137 + daughters

Residential SPRG

- > 4.0 uCi/m2
- > 0.4 uCi/m2
- > 0.04 uCi/m2
- > 0.0040 uCi/m2

Compare Cleanup Approach Determined for RDD to the IND Scenario

- What recommendations would need to be changed or adjusted based on this level of contamination?
- How would the decision process and rationale be different from RDD to IND?

TTX Participants
Region 9 primarily

- 5 RPMs
- 7 OSCs and removal managers
- 6 Radiation support
- 4 Homeland security support
- 4 CICs

TTX Issues

- TTX good idea, made participants think about long-term recovery and response issues
  - Improve TTX, but keep doing them with other Regions
- Focus more on RDD, less on IND
- Be more specific about EPA and other agencies roles
  - Better reconcile PAGs, emergency response and long-term cleanup

TTX Issues, continued

- More linkage to early and intermediate response actions
  - » What cleanup actions are completed
  - » What decisions have been made or processes established (e.g., disposal location, decon procedures)
- Include non-Superfund divisions (e.g., air, water)
- Tie the 3 discrete areas (urban, suburban, rural) together with common elements (e.g., monitoring)
- Be more specific about expected outcomes
  - » What do you want us to accomplish?